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Revisions

11-01-2017	Revised Section 4.7.2.A.3), Section 4.7.2.B.3), Section 4.7.3, Section 4.7.4b) & c)
01-26-2018	Revised Section 7.1.2.3.i.1.vii and Section 7.1.3.3.f.2
10-24-2018	Revised Section 4.7.3 RCC thickness

Chapter 1: General

1.1 Introduction

The City of Hilliard Engineering Design Manual (hereinafter the "Manual") has been developed to promote uniformity in the application of engineering practices, policies, and guidelines with respect to the design of all public works within the public right-of-way or easements. Public works include street, stormwater management (quality and quantity), water, sanitary sewer, pedestrian and bicycle facilities, structures, traffic signals, maintenance of traffic, street lighting, signing and pavement marking, and landscaping. The intent of the Manual is to provide standards and best practices to the designer. It is not intended to supersede requirements of law nor engineering judgment and sound principles by a knowledgeable design professional.

The Engineer responsible for applying the concepts and practices assembled in this Manual is required to hold current registration as a Professional Engineer in the State of Ohio with experience in the discipline in which the plans are being prepared.

While this Manual compiles guidelines, practices, and requirements from a variety of sources, it is not warranted or represented to be comprehensive in every respect. Engineering knowledge, experience, and judgment must always be used to determine whether, and how, to apply the information included herein to specific situations.

New or different design techniques presented herein or contemplated in the future with new technology or materials do not imply that existing public works designs are unsafe or unsuitable nor do they mandate the initiation of improvement projects to meet current design standards. However, if a rehabilitation project or modification of existing infrastructure is being contemplated as a public- or privately-funded project, attempts should be made to reasonably upgrade infrastructure to meet current design guidelines and/or City standards.

1.2 Engineering Plan Review and Approval Process

All proposed work in public right-of-way or public easement in the City of Hilliard is subject to review by the Engineering Division to verify conformance to current City design requirements, standard drawings and construction standards, specifications, and regulations. The information contained herein is updated per the revision date on the cover, and should be considered to supersede all previous documents. This document is supplemental to the Codified Ordinances of the City of Hilliard.

Plan approval is subject to the specific application and can generally be categorized into one of the following three classifications: Capital Improvement Projects, Private Development Projects, and Private Utility Projects. As-builts for Commercial development projects must be submitted in order to receive a certificate of occupancy.

1.2.1 Capital Improvement Projects (CIP)

Capital Improvement Projects include street, storm, water, traffic signal, sanitary sewer, bike/pedestrian, street lighting, signing or pavement marking projects, or other public works projects located in public right-of-way or easements that are funded through City or other public agency capital dollars.

1.2.1.A. The Process

For CIP work, the plan review and approval process and project submittal schedule shall be coordinated with the City of Hilliard project manager in order to meet City expectations, priorities, and budgets. Project coordination with private utilities is the responsibility of the design consultant unless otherwise arranged in the project scope.

1.2.1.B. Plan Review Timeline

For small design projects that are limited in scope, plan submittals may be combined and review times can be expected between two (2) to four (4) weeks. For larger or more complex projects, plan submittals may be split into disciplines and review times may be longer. All review times stated above are estimates and are also dependent on work load and staff availability.

1.2.1.C. Plan Signatures and Permits

The City project manager will obtain all City official signatures or permits required for final plan approval for CIP work. It is the responsibility of the design consultant to obtain all other necessary signatures or permits on behalf of the City.

1.2.2 Private Development Projects

Private Development Projects can be categorized into one of the following three classifications: subdivision projects, thoroughfare plan street projects, and residential/commercial building permit projects.

1.2.2.A. Subdivision Projects

Subdivision Projects include residential subdivisions with local streets and utilities to be dedicated as public infrastructure.

1.2.2.A.1 The Process

Subdivision Projects will be reviewed using a three-step process unless the size or scope of the project requires a further breakdown of the process. Step 1 is the preliminary design, which corresponds to a 30%-complete submission. Step 2 is the detailed design, which corresponds to a 90%-complete submission. Step 3 corresponds to final plans and title sheet. In some cases, upon request by the Developer, the City Engineer may approve combining two of these steps in the process. Each submittal shall be complete and include all necessary plans, calculations, studies, and reports required for review of the corresponding submittal. If the documents are deemed incomplete, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the required plans for review. The City will not review partial plan submissions. All final plans or reports shall be signed and sealed by the design engineer. Coordination of the project with private utilities is the responsibility of the design engineer, and plan revisions resulting from conflicts with private utilities may result in a modified process.

1.2.2.A.2 Plan Review Timeline

Plans are reviewed in the order in which they are received and logged into the official City of Hilliard plan tracking system. Incomplete plans submissions will not be logged into the tracking system. For 30% submission the estimated review times can be expected to be between two (2) and four (4) weeks depending on the complexity of project. For 90% submission the estimated review times can be expected to be between one (1) and three (3) weeks depending on the complexity of project. Final review and/or back checks typically can be done in one (1) week. All review times stated above are estimates and are also dependent on workload and staff availability. Holidays or scheduled leave shall be factored into these timelines.

1.2.2.A.3 Plan Signatures and Permits

The design consultant shall obtain all necessary signatures or permits required for the plans.

1.2.2.B. Thoroughfare Plan Street Projects

Thoroughfare Plan Street Projects include projects that construct new streets or modify existing streets or intersections. This includes turn lane work, shoulder widening, addition/modification of traffic signals or pedestrian/bicycle facilities to accommodate private development projects that are designated as arterial or network collector on the City of Hilliard Thoroughfare Plan.

1.2.2.B.1 The Process

Because Thoroughfare Plan Street Projects can vary drastically in terms of size and scope, these projects will be reviewed using a process similar to CIP work designated in Section 1.2.1 and the developer's schedule will be factored into the process. Each submittal shall be complete and include all necessary plans, calculations, studies, and reports required for review of the corresponding submittal. If the documents are deemed incomplete, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the required plans for review. The City will not review partial plan submissions. All final plans or reports shall be signed and sealed by the design engineer. Coordination of the project with private utilities is the responsibility of the design engineer, and plan revisions resulting from conflicts with private utilities may result in a modified process.

1.2.2.B.2 Plan Review Timeline

Plans are reviewed in the order in which they are received and logged into the official City of Hilliard plan tracking system. Incomplete plans submissions will not be logged into the tracking system. For each plan submittal the expected review time shall be between two (2) and four (4) weeks. For larger or more complex projects, plan submittals may be split into disciplines and review times may be longer. All review times stated above are estimates and are also dependent on work load and staff availability. Holidays or scheduled leave shall be factored into these timelines.

1.2.2.B.3 Plan Signatures and Permits

The design consultant shall obtain all necessary signatures or permits required for the plans.

1.2.2.C. Residential/Commercial Building Permit Projects

Residential/Commercial Building Permit Projects include the review of multi-family (rental or condominium ownership) or commercial civil/site plans to ensure that they meet the requirements of the City zoning code and that utilities are designed to meet the requirements of this Manual. These projects are coordinated through the City of Hilliard Building Division with support from the Engineering and Planning Divisions.

1.2.2.C.1 The Process

Residential/commercial building projects will be reviewed using a two-step process unless the size or scope of the project requires a further breakdown of the process. Step 1 is the preliminary design, which corresponds to a 30%-complete submittal. This plan submittal shall precede and be independent of any Building Division plan submittal. Step 2 corresponds to final plans and title sheet. This plan submittal may be either part of the initial Building Division plan submittal or be independent of this submittal. Approval of the final plans must precede any Building Division plan submittal. Each submittal shall be complete and include all necessary plans, calculations, studies, and reports required for review of the corresponding submittal. If the documents are deemed incomplete, the applicant shall be notified in writing and shall have an opportunity to correct the deficiencies and resubmit the required plans for review. The City will not review partial plan submissions. All final plans or reports shall be signed and sealed by the design engineer. Coordination of the project with private utilities is the responsibility of the design engineer, and plan revisions resulting from conflicts with private utilities may result in a modified process.

1.2.2.C.2 Plan Review Timeline

Plans are reviewed in the order in which they are received and logged into the official City of Hilliard plan tracking system. Incomplete plans submissions will not be logged into the tracking system. For 30% submission the estimated review times can be expected to be between three (3) and four (4) weeks depending on the complexity of project. For Final submission the estimated review times can be expected to be between two (2) and three (3) weeks depending on the complexity of project. Final review and/or back checks typically can be done in two (2) weeks. All review times stated above are estimates and are also dependent on work load and staff availability. Holidays or scheduled leave shall be factored into these timelines.

1.2.2.C.3 Plan Signatures and Permits

The design consultant shall obtain all necessary signatures or permits required for the plans.

1.2.2.D. Residential/Commercial Right-of-Way Projects

All agencies or individuals performing any construction or occupancy activity in the public right-of-way are required to submit a right-of-way permit with the City of Hilliard Division of Engineering. The public right-of-way includes the street pavement, curb, sidewalk, tree lawn, and driveway approaches.

1.2.2.D.1 The Process

The applicant shall obtain and complete a right-of-way permit application and submit the form to the Engineering Division. Each application submittal shall include necessary plans. Any work requiring lane closure or working in or near traffic shall submit a Maintenance of

Traffic (MOT) plan in compliance with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). Off-duty City of Hilliard police officer(s) will be assigned to the project when deemed necessary and will be paid for at the Contractor's expense. Payment in full of the permit fee must accompany the application. Permit applications and associated plans will not be reviewed, approved, or issued until fees are paid in full. The City's Construction Inspector shall be notified by the applicant prior to the start of the work. Requests for night or weekend work shall be made in writing to the Director of Public Service as a request for the extension of work hours. This request shall be in accordance with the requirements of Section 509.08(b) of the City's Codified Ordinances.

1.2.2.D.2 Permit Review Timeline

Permit and plan review and approval may take up to five (5) to ten (10) working days. All review times stated above are estimates and are also dependent on work load and staff availability. Permits are logged into the City of Hilliard plan tracking system and a copy of the approved permit with receipt will be provided to the applicant. A copy of the permit shall be available at the job site.

1.2.2.D.3 Right-of-Way Permit Types and Fees

a) Excavation Permits (Construction)

An excavation permit is needed when excavating within the right-of-way of any public street or alley. The work covered by this permit includes excavations in street or alley pavement, sidewalk, driveway, or the non-paved area with-in the right-of-way for any purpose whatsoever. The application fee for an excavation permit (construction) is $100.

b) Occupancy Permits (Minor Maintenance)

An occupancy permit is needed when it is necessary to occupy the right-of-way of any public street or alley. It is necessary to obtain this permit when working on or in any roadway appurtenance, or when it is necessary to occupy a portion of public right-of-way for any reason including, but not limited to, work on or in buildings or properties outside the right-of-way. The application fee for an occupancy permit (minor maintenance) is $50.

1.3 Engineering Plan Review and Construction Inspection Fees

This section is applicable only to Private Development Projects.

1.3.1 Required plan review and inspection fees for private development projects as set forth in the City of Hilliard's Development Code 1181.11 (c) & (d) established by Ordinance 01-77, the City's Comprehensive Fee Schedule Ordinance 08-35 and said fee schedule as amended by Resolution 08-R-41.

1.3.2 This policy is established in conformance with Hilliard City Code 1181.11 (c) & (d) established by Ordinance 01-77 adopted by City Council on December 17, 2001. It applies to all development projects involving the construction, modification, addition, or removal of public infrastructure. This includes, but is not limited to, roadway components, storm sewers, waterlines, sanitary sewers, street lights, traffic signals, grading, sidewalks, bike paths, bridges, culverts, and erosion and sediment control measures both temporary and permanent.

1.3.3 Use of Standard Construction Costs: An Ohio-registered professional engineer shall prepare an estimate of the construction cost based on unit prices. Engineer's estimates or opinions of probable construction cost must be based on construction cost unit prices that use "Prevailing Wage" consistent with Ohio law. This estimate shall be submitted to the City Engineer for review and approval. Once approved, this engineer's estimate shall be used to determine the amount of plan review and construction inspection fees that are to be paid by the developer and/or applicant.

1.3.4 City of Hilliard establishes that the Engineering Division shall collect plan review and construction inspection fees for the cost associated in providing these services. Fees are calculated as follows:

1.3.4.A. Subdivisions

Fees for plan review for subdivisions shall be four (4) percent of the estimated construction cost for all public improvements or modifications, as described above.

1.3.4.B. Private Improvements

Fees for private improvements such as commercial/industrial civil/site plans shall be four (4) percent of the estimated construction cost for all public improvements associated with the project plus the storm water management and erosion and sediment control provisions, site grading, sidewalks, driveways, etc. that are subject to the purview of the City Engineer for code compliance and engineering standards.

1.3.4.C. Code Compliance and Engineering Standards

In addition to the review fees for the public improvements portions of private civil/site plans, a plan review fee shall be two (2) percent of the estimated construction cost of the private work that is subject to the review of the City Engineer for code compliance and engineering standards.

1.3.4.D. Construction Inspection

Fees for construction inspection services shall be ten (10) percent of the estimated construction cost for all public improvements or modifications, as described above.

1.3.5 Plan Review Fee and Construction Inspection Fee Content

1.3.5.A. General

All fee payments shall be provided with a certified construction cost estimate prepared by the Ohio-registered professional engineer responsible for the project "Drawing of Record." Each item of work, or pay item related to public improvements or modifications to public improvements, as defined above, shall be included in the construction cost estimate.

1.3.5.B. Construction Cost Summary

The construction cost summary shall be signed, sealed, dated and show, in tabular format, the pay item number according to City of Columbus and/or Ohio Department of Transportation

specifications, the pay item name in full, the unit of measure, the approved quantity, and the standard unit price.

1.3.5.C. Construction Cost Estimate

The total construction cost of each pay item shall be calculated by multiplying the quantity used by the standard unit price. The construction cost estimate shall be tabulated by row with a total cost displayed at the bottom of the calculated cost column. The total construction cost estimate shall be multiplied by four (4) percent for subdivision and private improvements plan review fees, and ten (10) percent for construction inspection fees, with the product rounded to the nearest ten (10) dollars. Fees shall be paid according to the fee submission schedule below.

1.3.6 Plan Review Fee and Construction Inspection Fee Submission Schedule

1.3.6.A. Plan Review Fee

The developer or his agent shall submit three (3) copies of construction drawings, supporting calculations, and exhibits for review by the Division of Engineering to the office of the City Engineer. A certified lump sum cost estimate, based upon the anticipated plan quantities shown on the construction drawings, shall be submitted on the "Preliminary Project Cost Estimate" form with the drawings and a down payment of the Plan Review Fee in an amount of fifty (50) percent of the anticipated final Plan Review Fee. The balance of the Final Plan Review Fee as established by the approved engineer's estimate is payable at the time the plans are submitted for Final Plan Review.

1.3.6.B. Plan Review Fee Reconciliation

A final certified construction cost estimate shall be submitted on the City's standard "Final Project Cost Estimate" form, based upon the final approved plan quantities shown on the construction drawings fully approved by the appropriate review agencies. The amount of the previously submitted fees shall be subtracted from the final estimated total cost to determine the balance of the plan review fee due.

1.3.6.C. Construction Inspection Fee

A copy of the certified construction cost estimate shall be submitted on the City's standard "Final Project Cost Estimate" form, based upon the plan quantities shown on the construction drawings fully approved by the appropriate review agencies. The construction inspection fee shall be submitted for payment to the office of the City Engineer either before or at the time of the pre-construction meeting for the project. In the event the City does not hold a pre-construction meeting, fees must be submitted to the office of the City Engineer prior to plan approval and scheduling of any construction activities.

1.3.6.D. As-Built Quantities

Field changes and adjustments to plan design resulting in changes to approved plan quantities during construction shall not cause changes to the amount of the plan review or construction inspection fee already submitted.

1.3.6.E. Refunds

No portion of the plan review or construction inspection fee is refundable.

1.4 Engineering Plan Format and Content

Plan format and content is based on the size and complexity of the project. Large capital improvement projects will typically follow an ODOT-type of plan format. Private development projects will typically follow an abbreviated plan format. Private utility projects may only include limited detail depending upon the type and scope of work being conducted.

1.4.1 All Projects

The following information shall be considered the minimum requirements for all plans:

1.4.1.A. Plan size:

22" x 34" (full size)
11" x 17" (half size)

1.4.1.B. Plan scale:

Horizontal: 1" = 20' (unless otherwise noted) shown in written and graphical format.
Vertical: 1" = 5' (unless otherwise noted) shown in written and graphical format.

1.4.1.C. Hilliard Plan Number:

A record plan number for each project containing public infrastructure shall be obtained from the City of Hilliard project manager and shall be included in the bottom right corner of each plan sheet.

1.4.1.D. Half Size

Text size and line work used on all plans shall be legible in half size.

1.4.2 Capital Improvement Projects (CIP)

Capital Improvement Projects will typically follow an ODOT-type of plan format.

1.4.2.A. Plan Submissions

All plan submissions shall contain one full-size plan set, one half-size plan set, and one electronic (PDF) plan set for all plans and supporting documentation submitted. All paper and electronic plan submissions shall be to scale. In addition to the above, final plan submissions shall include a bound half-size set with a heavy duty back and clear front cover and electronic AutoCAD files with all layers labeled in a logical manner.

1.4.2.B. Plan Organization

Plans shall be organized in a logical manner in the general order listed below. Small or simple projects may combine some of the information on sheets. Large or more complicated projects may require additional sheets to adequately depict the design information. Engineering judgment should be used to determine the level of detail necessary, but in all cases, the detail provided shall be sufficient and legible to construct the proposed improvements. The design consultant should review the project details with the City project manager prior to plan submission to ascertain the level of detail needed.

1. Title Sheet, including the engineer's seal/signature, all approval signatures, location map, and sheet index
2. Schematic Plan
3. Typical Sections
4. General Notes
5. General Summary
6. Details (Scale: 1" = 10')
7. Erosion & Sediment Control and/or Stormwater Management Plan
8. Plan and Profile
9. Cross sections at 50-foot intervals (Scale: 1" = 5' vertical and 1" = 10' horizontal)
10. Pavement and/or Intersection Details
11. Waterline Plan and Profile
12. Storm Sewer Profiles
13. Traffic Control (Signing & Pavement Marking)
14. Traffic Signal Plan and Details
15. Lighting Plan and Details
16. Landscape Plan and Details
17. Maintenance of Traffic Plan

1.4.3 Private Development - Thoroughfare Plan Street Projects

Follow content and format detailed in Section 1.4.2 Capital Improvement Projects (CIP).

1.4.4 Private Development - Subdivision Projects

1.4.4.A. Plan Submissions

1.4.4.A.1 All plan submissions shall contain two full-size plan sets. Final plan submissions shall include four (4) full-size sets of plans, four (4) half size sets of plans, one electronic (PDF) set of plans (printable to scale), and the electronic AutoCAD files with all layers labeled in a logical manner.

1.4.4.A.2 All drawings shall have the orientation of north being the top of the sheet or being to the right of the sheet. Lettering shall be orientated so that it is legible from either the bottom or the right side of the sheet.

1.4.4.A.3 All plan sheets shall be titled and numbered, with the Title Sheet being sheet No. 1.

1.4.4.A.4 A North arrow shall be provided on all plan views.

1.4.4.A.5 Both a written and a graphical scale shall be provided on all plans, profiles and details.

1.4.4.A.6 A clear distinction shall be made between proposed and existing elements of the plan.

1.4.4.B. Plan Organization

Plan sheets shall be organized in the order and with the content listed below:

1.4.4.B.1 Title Sheet

This sheet identifies the project and provides information for the project location. The title sheet shall have the following information:

a) Title Block at top of sheet including:
   1) Title of Plan (i.e. Public Sanitary Sewer; Public Street, Storm Sewer, Water Line & Street Lighting; etc.).
   2) Project Name.
   3) City of Hilliard, Ohio.
   4) Year of Design.
   5) Hilliard Record Plan Number (to be provided by the City).

b) Location map (Scale: 1" = 1000'), locating the project in the City's vicinity.
c) Site Index map (Scale: either 1" = 100' or a maximum 1" = 200') showing:
   1) General site layout.
   2) Identification of site parcel, including property owner and parcel number.
   3) Edges of pavement of all abutting streets.
   4) Street names, both existing and proposed.
   5) Municipal corporate boundaries.
   6) Site boundaries with bearings and distances.
   7) Identification of adjacent parcels, including County Auditor's parcel number, property address, property lines, and property owner name.
   8) Proposed and existing rights-of-way, property lines.

d) All applicable Standard Drawings.
e) Index of sheets.
f) OUPS Notification to Dig Phone Number.
g) Benchmark list, based upon NAVD 88.
h) City of Hilliard signature approval and date, including technical details disclaimer.
i) Norwich Township Fire Department signature approval and date.
j) City of Columbus Utilities signature approval and date, including reference note for water and/or sewer agreement between the City of Hilliard and the City of Columbus.
k) Signature, seal, date of signature, and registration number of the engineer of record.
l) Standard revision block.
m) Developer/Owner and design firm names, addresses, and telephone numbers.

1.4.4.B.2 General Notes Sheet

This sheet shall include the most current edition of City of Hilliard general notes for streets, sewers, water lines, fire hydrants, and any other utilities, as well as any special notes as required. The numbering system of the City's standard notes shall be maintained and shall not be changed. Any deletions to the general notes shall be shown in a note at the end of each section of standard notes. This note shall read: "The following Notes have been deleted: AA. BB., XX., YY., ZZ."

1.4.4.B.3 Estimate of Quantities Sheet

Estimate of Quantities are to be presented in tabular form using the City of Columbus or ODOT Item Number or specifying otherwise. All phases of the project must be clearly broken out in the quantity table and on all plan sheets. This table could be included on the General Note sheet or the Typical Section & Details sheet. Placing this table on the title sheet is strongly discouraged. These quantities must contain, at a minimum: Item Number, Quantity, Unit and Description.

1.4.4.B.4 Typical Section & Details Sheet

This sheet is used to show the street typical section and any additional pertinent detail drawings needed to adequately describe the construction process. It should include:

a) Street Typical Sections.
b) Intersection Details.
c) Handicap Curb Ramp Details.
d) Other applicable construction details.

1.4.4.B.5 Site Survey/Existing Topographic Plan

This sheet shall provide all easement and boundary information as well as existing structures. It shall be provided on an as-necessary basis at the discretion of the City Engineer.

1.4.4.B.6 Roadway Plan and Profile Sheets (Including Waterline Details)

This plan shall include all information necessary for the construction of the proposed roadway improvements within existing or proposed right-of-way or easements. This plan shall contain the following minimum information.

a) Existing topographic features within development area.
b) Existing and proposed right-of-way and property line information.
c) Identification of adjacent parcels, including property owner name, address and County Auditor's parcel number.
d) Location of all known utilities, both public and private.
e) Centerline stationing of proposed road.
f) Centerline bearing of proposed road.
g) Horizontal curve data for proposed road including points of curvature (PC) and points of tangency (PT) on the plan.
h) Profile showing profile grade elevations for both the proposed road and existing ground.
i) Vertical curve information on the proposed road profile.
j) All utility crossings, both public and private.
k) Location, size, and type of all storm sewer structures.
l) The public water main shall be shown on the street plan and profile sheet.
m) Location of all service taps, fire hydrants, fittings, and valves on both the plan and profile.
n) Provide a table with blank columns for as-built state plane coordinates for all water line appurtenances, including fire hydrants, valves, fittings and services. Stationing should also be shown on this table for all appurtenances except for service lines.

o) All backfill and lines of influence shall be shown and labeled with type and station.
p) Superelevation tables.

1.4.4.B.7 Storm Sewer Profiles

The following information is required on all storm sewer profile sheets.

a) Minimum Scale: 1" = 20' Horizontal and 1 = 5' Vertical.
b) Stationing of storm sewer shall begin at most downstream structure and continue upstream.
c) The storm profiles shall show the size, slope, pipe material and/or class of proposed pipe.
d) All proposed utility crossings.
e) The normal water service elevation must be shown at all end-of-run locations where the storm system empties into a retention basin.
f) Structure and headwall types.
g) All backfill types and limits are to be shown and stationed.
h) Location of all proposed manholes, catch basins, inlets, vaults, structures, etc., with type of structure and coordinates or stationing. Storm sewer top of casting, invert, window and orifice elevations.
i) All areas requiring fills to be constructed prior to storm sewer installation per Columbus CMS 901.04 shall be shown with cross-hatching.

1.4.4.B.8 Culverts

A profile for each roadway culvert shall be provided showing invert, roadway edge of pavement and/or top of curb, roadway centerline, and design storm and 100-year headwater and tail-water elevations. A table with each profile shall also be provided showing the design and 100-year storm discharge values, head and tail water elevations and outlet velocities. Appropriate erosion control (i.e. rock channel protection type and size) must be shown.

1.4.4.B.9 Master Grading Plan

These sheets shall contain all information necessary for establishing grades and elevations for each proposed lot on the site. The proposed grades shall be coordinated with existing abutting property grading. This plan shall contain the following minimum information:

a) Existing contours (1-ft intervals) shall be labeled with elevations and shall extend 50 feet (minimum) beyond the project work limits to show adequate tie in.
b) Proposed elevation spot grades at the following locations:
    1) All property corners.
    2) Top of curb or edge of pavement at all side property lines extended to the street.
    3) Front building setback line on all side property lines.
    4) High point of all side property lines with the distance from front property line denoted.
    5) Rear yard swales at all side property lines, and possibly at center of lot if lot is extremely wide.
c) All existing and proposed utilities.
d) Proposed ground around the house elevation on all lots.

e) Sanitary and storm sewer top of casting elevations.
f) Proposed landscape mounding contours and proposed retention/detention basin contours.
g) Direction of flow arrows for normal drainage flows.
h) Major flood routing path arrows.
i) Ditch centerline, including direction of flow arrows and slope.
j) Any stream corridor protection zones (SCPZ) and their calculated width as defined in Chapter 7 of this Manual.
k) A typical lot legend for grading showing and labeling all of the items in section 1.4.4.B.9.

1.4.4.B.10 Storm Water Management Basin Details

Dimensioned cross sections and plan views for each water quality Best Management Practice (BMP) selected shall be shown. A table showing the required Water Quality Volume (WQv) and drawdown time, as well as the designed storage and designed drawdown time of the basin, shall be provided.

a) Storm Water Retention/Detention Basin Information.

    1) Maximum allowable storm water release rates as calculated per the requirements of Chapter 7 of this Manual for 1- through 100-year design storm frequency events.
    2) Actual storm water release rates calculated in the storm water management report for 1- through 100-year design storm frequency events.
    3) Storage required and provided for the Water Quality (WQ) and 1- through 100-year design storm frequency events that were calculated in the stormwater management report.
    4) Elevation of ponding at each of the calculated storm events in item 2) above.

b) Orifice plate location and details.
c) Spillway area location, designation, dimensions, and cross section, including overflow weir elevation.
d) Outlet design details.
e) Cross sections of detention basins, wet or dry, shall be provided and dimensioned. Side slopes, basin bottom slope, the elevation of each inlet and outlet structure, and maximum water surface elevations for WQv storage, the critical storm, and the 100-year design storm shall be annotated. An elevation view and plan view of each outlet riser structure shall be provided and annotated.
f) For all storm water retention/detention basins, the following must be designed per Chapter 7 of this Manual and shown:

    1) 100-year design storm pool elevation
    2) Pond contours with side slopes noted
    3) Emergency overflow (spillway) location
    4) Normal pool elevation
    5) Safety shelf or submerged bench
    6) 1-foot minimum freeboard from 100-year design storm elevation to top of bank

1.4.4.B.11 Sanitary Sewer Plan

This plan shall contain all information of the proposed sanitary sewer, services, and easements. The sanitary plan may be submitted as a separate submission, however, it must contain all elements of a plan set, including but not limited to a title sheet, a complete set of general notes, quantities, detail drawings, and plan and profile of the proposed sewer. This plan shall contain the following minimum information.

a) All existing and proposed sanitary sewer and other utilities showing size, length, and type and/or class.
b) Sanitary sewer services information in tabular form, including station, size, riser height, extension length, slope, and elevation at end of service.
c) All edge of pavement and building lines.
d) Proposed pad and finished floor elevations of all proposed structures.
e) Property lines, rights-of-way, and easements.
f) A tributary map shall be included either as a separate sheet or on the title sheet as part of the index map depending on the size of the project.
g) A table with State Plane Coordinates for each proposed sanitary sewer manhole. The table must include blank columns for as-built location information for all sanitary sewer manholes.
h) Stationing, bearings, and distances (center of structure to center of structure) for all sanitary sewer main lines.

The following information is required on all sanitary sewer profile sheets.

a) Minimum Scale: 1" = 20' Horizontal and 1" = 5' Vertical.
b) The elevations of all tie-in points shall be field verified.
c) Sanitary sewer profile indicating size, slope, and type of proposed sanitary sewer.
d) Existing and proposed grade above the sanitary sewer.
e) All proposed utility crossings.
f) Sanitary sewer top of casting and invert elevations.
g) Locations of clay trench dams.
h) Location of temporary bulkhead per Columbus CMS 901.13
i) All backfill and lines of influence shall be shown and labeled with type and station.
j) Bedrock and groundwater table elevation (if known) shall be shown in all profiles.

1.4.4.B.12 Erosion & Sediment Control Plan and Details Sheets

These sheets are to be submitted as part of the plan set as well as the Stormwater Pollution Prevention Plan (SWP3). The site grading shall serve as the base information for the erosion and sediment control plan. Erosion and sedimentation controls shall meet the minimum requirements of the OEPA and the City of Hilliard. All erosion and sediment controls shall be designed in accordance with the requirements of the most recent edition of the Ohio Department of Natural Resources Rainwater and Land Development Manual. The erosion and sediment control plan shall contain the following minimum information.

a) Inlet protection locations
b) Silt fence locations
c) Check dam locations
d) Construction entrance location
e) Staging area location

f) Fuel storage location
g) Concrete washout location
h) Material and debris storage location
i) Stream crossing locations
j) Location and preventative measures taken for any other construction activities that may impact stormwater runoff
k) Temporary sediment settling basin locations
l) Standard erosion control notes, including a sequence of construction
m) Sediment and erosion control standard details
n) Stream crossing details
o) Sediment basin and temporary outlet structure details
p) Sediment and erosion control quantities, if not shown on Estimate of Quantities sheet

1.4.4.B.13 Traffic Control Plan (Signing and Pavement Marking), Street Name Sign, & Street Lighting Plan

These sheets are to be submitted as part of the plan set and should include the following information:

a) General street layout showing all existing and proposed streets and striping
b) Street centerline and stationing
c) Signage and striping station and offset, including street name signage
d) Signage and Striping details and notes
e) Lighting notes
f) Lighting legend
g) Lighting details
h) Light pole locations (station and offset)
i) All lighting cable and wiring, including dimensions from property lines and ROW lines
j) Pull box locations
k) Service enclosure locations
l) Power company's transformer locations
m) All traffic control and street lighting quantities, if not shown on Estimate of Quantities sheet

1.4.4.B.14 Landscape Plan

These sheets are to be submitted as part of the plan set and should include the following information:

a) Planting & landscaping notes
b) Tree planting location and type
c) Mounding locations
d) Retail sign locations (monument signs only, not building signs)

1.4.5 Private Development - Residential/Commercial Building Projects

1.4.5.A. Plan submissions

Refer to section 1.4.4.A for the requirements for this section

1.4.5.B. Plan Organization

Plans shall be organized in a logical manner in the order of and with the content listed below.

1.4.5.B.1 Title Sheet

Refer to section 1.4.4.B.1 for the requirements for this section

1.4.5.B.2 General Notes Sheet

Refer to section 1.4.4.B.2 for the requirements for this section

1.4.5.B.3 Schematic Plan

1.4.5.B.4 Site Survey/Existing Topographic Plan

Refer to section 1.4.4.B.5 for the requirements for this section

1.4.5.B.5 Site Demolition Plan

This sheet shall be provided on an as-necessary basis to provide clarity for projects that will be removing existing buildings and structures. It may be combined with the Site Survey Plan at the discretion of the design engineer and with approval of the City Engineer.

1.4.5.B.6 Site Dimension Plan

The site dimension plan shall contain all information necessary for the establishment of the proposed horizontal dimensions of the site including, but not limited to, the proposed building pad(s) location, pavement width, setback with width and description, rights-of-way width, property lines, easements with width and description, curb radii, sidewalks width and material, and bike paths width and material. The plan shall contain the following information with appropriate elements clearly dimensioned and labeled:

a) Site layout, to scale, showing existing/proposed buildings, structures, roads etc.
b) Existing/proposed driveway and parking areas with materials.
c) Barricade locations.
d) Waterways such as streams, lakes ponds etc.
e) Existing/Proposed detention/retention basins.
f) Existing tree/vegetation limits.
g) Clearing limits, adjoining property lines, existing/proposed utility easements with width and descriptions.
h) All property lines, labeled with bearing and distance.
i) All adjoining property information, including owner's name, address & County Auditor's parcel number.
j) Property size and lot number (as applicable).
k) Current zoning of the property.

l) Any FEMA designated floodway, 100-year floodplain, or OEPA required setback (as applicable).
m) Any Stream Corridor Protection Zones (SCPZ) and their calculated width as defined in Chapter 7 of this Manual.
n) All required vehicular access restrictions to public streets.
o) All required emergency vehicle accesses with dimensions.
p) All existing and proposed rights-of-way, easements (including type), and no-build zones, including the widths of each.
q) Centerline with Hilliard Record Plan reference where applicable, edge of pavement and/or back of curb, and right-of-way of all adjacent public or private streets. Dimension the total width of the street (note EP – EP or BC – BC) and right-of-way (proposed and existing).
r) Dimension all proposed pavement and parking lot areas. This should include the pavement width, radius returns of curbs, number of parking spaces, including their length and width, and drive aisle width.
s) Size, location, and type of all proposed sidewalks or bike paths including all ramps to be built on site or within the public right of way.
t) Location and proposed size of all dumpster enclosures and pads.
u) All required front, side, and rear yard setbacks, including all building and pavement setbacks.
v) All proposed and/or existing ingress/egress, access, or cross access easement aisles, drives, or driveways.
w) All handicap stall locations with dimensions and striping.

1.4.5.B.7 Utility Plan

These sheets shall contain all information for the underground and aboveground utilities. Easements, rights-of-way, and pipe alignments shall be included. Existing and proposed storm sewer, sanitary sewer, waterline, field tiles, roof drains, gas lines, electric lines, fiber optic lines, cable lines, and associated services shall be shown. This plan shall contain the following:

a) All existing (dashed) and proposed (solid) utilities including all field tiles and drainage ditches.
b) Size and type (water, sanitary, etc.) of proposed and existing utility services, mains, and tees.
c) Invert at proposed building and end-of-service elevations of sanitary services in tabular form.
d) Proposed pad and finished floor elevations.
e) Location of all fire hydrants, meters, valves, and related service taps.
f) Gas line and utility pole locations.
g) Property lines, easements, and right-of-ways.
h) Distance and material of storm and/or sanitary main lines, measured from center of structure to center of structure, in tabular form as appropriate to plan set.
i) Location of all proposed manholes, catch basins, inlets, vaults, structures, and other manmade utility structures with coordinates, descriptions and inverts.
j) A table with State Plane Coordinates that includes blank columns for as-built information for storm structure, water structures (valves and fire hydrants only), and sanitary manholes.

1.4.5.B.8 Storm Sewer Profiles

Refer to section 1.4.4.B.7 for the requirements for this section

1.4.5.B.9 Master Grading Plan

Refer to section 1.4.4.B.9 for the requirements for this section

1.4.5.B.10 Storm Water Management Basin Details

Refer to section 1.4.4.B.10 for the requirements for this section

1.4.5.B.11 Erosion & Sediment Control Plan and Details Sheets

Refer to section 1.4.4.B.12 for the requirements for this section

1.4.5.B.12 Sanitary Sewer Plan

Refer to section 1.4.4.B.11 for the requirements for this section

1.4.5.B.13 Roadway Improvement Plan and Profile Sheets (Including Waterline Details):

Refer to section 1.4.4.B.6 for the requirements for this section

1.4.5.B.14 Intersection Detail Sheets

a) Minimum Scale: 1" = 10'
b) Intersection details that include curb return curve data, intersection grading
c) Centerline bearing
d) Centerline and gutter line (edge of pavement) slopes
e) Angle between intersecting centerlines
f) Proposed locations, spot elevations and slopes for all handicap ramps. The ramps shall comply with all current ADA standards

1.4.5.B.15 Roadway Cross-Sections

These are required at 50-ft intervals (minimum) when a ditch section is used or a ditch exists beyond the back of curb.

a) Minimum Scale: 1" = 10'.
b) Roadway cross-sections, showing existing and proposed utilities and right-of-way limits.
c) Right-of-way lines and easements.
d) Roadway center line and elevation.
e) Existing and proposed cut and fill sections.
f) Ditch side slopes.
g) Grade tie-in points.

h) Longitudinal ditch slope.

1.4.5.B.16 Maintenance of Traffic Plan

a) Traffic control and maintenance information during construction including all temporary signage, signals, pavement markings, and barrel and barricade locations.
b) MOT phasing with written description.
c) MOT Details and references to ODOT standard drawings.
d) Cross sections showing lane widths or work zones.

1.4.5.B.17 Traffic Control Plan (Signing and Pavement Marking)

a) General street layout showing all existing and proposed streets and striping
b) Street centerline and stationing
c) Signage and striping station and offset
d) Signage and Striping details and notes

1.4.5.B.18 Lighting Plan & Fiber Optic Line Plan.

a) General site layout
b) Light pole locations (station and offset)
c) Lighting Notes
d) Street lighting control circuit diagram
e) Lighting distribution diagram
f) Lighting details
g) Fiber optic line and pull box location per project design requirements.

1.4.5.B.19 Landscape Plan

a) Mounding
b) Tree planting location and type
c) Planting Notes
d) Retail sign locations (monument signs only not building signs)

1.5 Limitations on Plan Approval

Significant construction of improvements must commence within three (3) years of final engineering plan approval. Engineering plan approval shall expire if the improvements have not commenced in this time frame and the plans must be resubmitted for approval with all relevant fees. Furthermore, the resubmitted plans shall be updated to the most current City of Hilliard design standards. Simply resubmitting previously approved plans will not be permitted.

1.5.1 The initial submission of an engineering plan for review must contain the items denoted below. Incomplete submittals will not be reviewed until all required materials have been received by the Engineering Division.

1.5.1.A. Two (2) sets of the signed and sealed Storm Water Management Plan (including all calculations) based on the requirements set forth in this Manual.
1.5.1.B. Two (2) sets of signed and sealed domestic water supply hydraulic calculations (water model) demonstrating conformance to City's fire prevention regulations.

1.5.1.C. Three (3) sets of signed and sealed plans as further detailed below, submitted on ANSI D (22"x34") bond paper.

1.5.1.D. Two (2) copies of signed and sealed storm sewer calculations including a tributary area drainage map identifying all onsite and offsite areas tributary to each of the proposed storm sewer inlets. The tributary area map shall be submitted on ANSI D (22"x34") bond paper.

1.5.1.E. Two (2) sets of signed and sealed sanitary sewer calculations. The sanitary sewer tributary map is to be delineated on the title sheet of the plan set.

1.5.1.F. All plan review fees must be paid before the City will commence the review process (See Section 1.3 Plan Review Fees).

1.5.2 Final Approval - The following items must be submitted before the project is approved and released for construction activities to begin. This list included herein is not intended to be all inclusive. It is the responsibility of the designer to submit any additional agency approvals prior to the pre-construction meeting as applicable.

1.5.2.A. One (1) copy of Notice of Intent to Discharge Stormwater (NOI) application and OEPA response letter containing the OEPA tracking number for all developments greater than one (1) acre.

1.5.2.B. One (1) copy of OEPA Permit to Install (PTI) public utilities application for projects extending all sanitary sewer utilities.

1.5.2.C. One (1) copy of Water Supply Data Sheets (WSDS) and the OEPA Project Summary Sheets, and the OEPA Permit to Install (PTI) public utilities application for projects extending all water supply utilities.

1.5.2.D. Two (2) copies of the SWP3 plan including narrative, plan sheets, and erosion control details.

1.5.2.E. Two (2) copies of the Operations & Maintenance Plan for all proposed storm water Best Management Practices (BMP's) on the project as required in Chapter 7 of this Manual.

1.5.2.F. Two (2) copies of the Inspection & Maintenance Agreement for all proposed stormwater BMP's on the project as required in Chapter 7 of this Manual.

1.5.2.G. All plan review fees must be paid before the City will commence the review process (See Section 1.3 Plan Review Fees).

1.5.3 Procedures for Plan Revisions

1.5.3.A. The City of Hilliard reserves the right to require any plan submitted for revision to be updated to the most current City of Hilliard design standards. The City of Hilliard reserves the right to perform a complete review of any plan submitted for revisions. Any errors or omissions not previously noted may be required to be corrected as a part of the revision process.

1.5.3.B. The following procedure is to be adhered to for all changes to the engineering plan set after the plans are approved. The purpose of the revision process is to account for unexpected field conditions and not for value engineering after the plan approval process. Value engineering is crucial, but it must be performed prior to final plan approval.

1.5.3.C. The engineer of record is to submit a draft of the requested changes with an accompanying written explanation to the City Engineer. The proposed changes shall be clearly identified in the plan set. Changes should be numbered both in the revision

block on the title sheet, the sheet title block where the revision occurs, and on the plan sheet itself, in close proximity to where the revision is being shown. The change number shall be inscribed in a triangle to help distinguish it from surrounding figures.

1.5.3.D. A review fee, as specified in the fees section of this document, shall be submitted before the Engineering Division will review any proposed plan revisions

1.5.3.E. Upon approval of the plan revision, the mylar title sheet shall be marked with the change and submitted to the City Engineer for their approval.

1.5.3.F. The final step in the revision process is the submittal of one (1) complete, full-sized copy of the revised plan set, three (3) full-sized, and three (3) half-sized copies of the revised sheets to the Division of Engineering. If the revision entails changes to more than 25% of the plan sheets, four (4) complete sets shall be submitted.

1.6 Right of Way Administration

1.6.1 Construction Permits

1.6.1.A. Construction Permit Requirements

Except as otherwise provided in the codified ordinances, no person may construct in any rights of way without first having obtained a construction permit as set forth in this chapter. This requirement shall be in addition to any requirement set forth in the City of Hilliard's codified ordinance chapters 905, 909, 913, 917 and 921 et seq. See section 907.01.3 of the codified ordinances for definitions.

1. A construction permit allows the permittee to construct and to obstruct travel, in the specified portion of the rights of way as described in the construction permit while placing facilities described therein, to the extent and for the duration specified therein.
2. Unless otherwise specified, a construction permit is valid for six (6) months from date of issuance for the area of rights of way specified in the permit.
3. No permittee may construct in the rights of way beyond the date or dates specified in the construction permit unless such permittee:
   a. Makes a supplementary application for another construction permit before the expiration of the initial construction permit; and
   b. Is granted a new construction permit or construction permit extension

4. Original construction permits issued under this chapter shall, when possible, be conspicuously displayed at all times at the indicated work site and be available for inspection by Inspectors and authorized City personnel. If the original construction permit is not conspicuously displayed at the indicated work site or the project involves work conducted simultaneously at multiple locations, then upon request, the construction permit must be produced within twelve (12) business hours.

1.6.1.B. Construction Permit Applications

Application for a construction permit shall be made to the Director of the Department of Public Service. In addition to any information required by the Director of Public Service, all construction permit applications shall contain, and will only be considered complete upon compliance with the following provisions:

1. Evidence that the applicant has been issued a certificate of registration or proof that the applicant has written authority to apply for a construction permit on behalf of a party that has been issued a certificate of registration; and

2. Submission of a completed construction permit application in the form required by the Director of Public Service, including, but not limited to, all required attachments, scaled, and dated drawings (or other information acceptable to the Director of Public Service) showing the location and area of the proposed project, number and location of street cuts, and the location of all existing and proposed facilities, accompanied by the certification of a registered professional engineer or other trained technical personnel acceptable to the Director of Public Service that the drawings, plans and specifications submitted with the application comply with applicable technical codes, rules and regulations; and

3. A City-approved traffic control plan demonstrating the protective measures and devices that will be employed, consistent with the Ohio Manual of Uniform Traffic Control Devices, to prevent injury or damage to persons or property and to minimize disruptions to efficient pedestrian and vehicular traffic; and

4. If the applicant proposes to replace existing poles with larger poles within the rights of way, the applicant shall, upon the reasonable request of the Director of Public Service, provide:

    a. Evidence satisfactory to the City that there is no excess capacity on existing poles or in existing underground systems; and

b. Evidence to the City that it is not financially and/or technically practicable for the applicant to make an underground installation or locate its facilities on existing poles; and

c. The location, size, height, color, and material of the proposed replacement poles; and

d. Evidence satisfactory to the City that the applicant will adhere to all the applicable laws concerning the installation of such replacement poles.

5. If applicant is proposing an underground installation in existing ducts or conduits within the rights of way, the applicant shall provide credible information satisfactory to the City to sufficiently detail and identify:

    a. The location, approximate depth, size, and quantity of the existing ducts and conduits.

6. If applicant is proposing an underground installation within new ducts or conduits to be constructed within the rights of way, the applicant must provide credible information satisfactory to the City to sufficiently detail and identify:

    a. The location, approximate depth, size, and quantity of proposed new ducts or conduits.

7. A preliminary construction schedule and completion date.

8. Payment of all money due to the City for:

    a. Permit fees; and

b. Any loss, damage, or expense suffered by the City as a result of applicant's prior construction in the rights of way or any emergency actions taken by the City; and

c. Any certificate of registration issued to the applicant/person whose facilities are being constructed; and

d. Any other money due to the City from the applicant/person whose facilities are being constructed.

9. When a construction permit is requested for purposes of installing additional systems or any part of a system, the posting of a construction bond and removal bond, acceptable to the City and subject to Section 907.21 of the codified ordinance for the additional systems or any part of a system is required.

1.6.1.C. Issuance of Construction Permit; Conditions.

1. If the Director of Public Service determines that the applicant has satisfied the requirements of this chapter and the construction permit process, the Director of Public Service shall issue a construction permit subject to the provisions of this chapter.

2. The City may impose reasonable conditions in addition to the rules and regulations enacted by the Director of Public Service, upon the issuance of the construction permit and the performance of the permittee thereunder in order to protect the public health, safety and welfare, to insure the structural integrity of the rights of way, to protect the property and safety of other users of the rights of way, and to minimize the disruption and inconvenience to the traveling public.

1.6.1.D. Construction Permit Fees

The Director of Public Service shall, after providing notice to and seeking input from all providers with systems in the City right of way, develop and maintain a schedule of permit fees in an amount sufficient to recoup all reasonable costs, as allowed by law. See Chapter 190 of the City's codified ordinance for fees. No construction permit shall be issued without payment of construction permit fees except to the City or County, which shall be exempt. Construction permit fees that were paid for a permit that the City has revoked due to breach are not refundable.

1.6.1.E. Joint Applications

Applicants are encouraged to make joint application for construction permits to work in the rights of way at the same place and time. Joint applicants shall have the ability to divide amongst themselves, in proportions the parties find appropriate, any applicable construction permit fees.

1.6.2 Construction, Relocation and Restoration

1.6.2.A. Technical Information Required

Prior to commencement of any initial construction of facilities in the rights of way a construction permittee, upon the reasonable request of the Director of Public Service, shall provide technical information about the proposed route of construction. The technical information required may consist of completion of the following tasks:

1. Secure all available "as-built" plans, plats, and other location data indicating the existence and approximate location of all facilities along the proposed construction route.

2. Visibly survey and record the location and dimensions of any facilities along the proposed construction route, including, but not limited to, manholes, valve boxes, utility boxes, posts, and visible street cut repairs.

3. Determine and record the presence of and the approximate horizontal and vertical location of all underground facilities the applicant or person on whose behalf the permit was applied for owns or controls in the rights of way along the proposed system route. Upon the reasonable request of the Director of Public Service, a permittee shall also record and identify the general location of all other facilities in the rights of way along the proposed system route. For the purposes of this section, general location shall mean the alignment of other facilities in the rights of way, but shall not necessarily mean the depth of other facilities in the rights of way.

4. If a provider records the information requested above in an electronic format, the provider shall provide the City with an electronic copy of the data obtained from completion of the tasks described in this section. Incorporation of the data required herein by electronic means shall include only data for new facilities that can be readily incorporated into the City's database.

5. Where the proposed location of facilities and the location of existing underground facilities appear to conflict with the plans as drafted, construction permittee has the option of either utilizing non-destructive digging methods, such as vacuum excavation, at the critical points identified to determine as precisely as possible, the horizontal, vertical and spatial position, composition, size and other specifications of the conflicting underground facilities, or redesigning the construction plans to eliminate the apparent conflict. A construction permittee shall not excavate more than a three (3) foot by three (3) foot square hole in the rights of way to complete this task.

6. Based on all of the data collected upon completion of the tasks described in this section, adjust the proposed system design to avoid the need to relocate other underground facilities.

7. All confidential/proprietary information submitted herein shall be so labeled.

1.6.2.B. Qualified Firm

All utility engineering studies conducted pursuant to this section shall be performed by a firm specializing in utility engineering or may be performed by the construction permittee if the construction permittee is qualified to complete the project itself.

1.6.2.C. Cost of Study

The construction permittee shall bear the cost of compliance with sections 1.6.2.C through 1.6.2.E of this section.

1.6.2.D. Construction Schedule

Unless otherwise provided for in this chapter, or unless the Director of Public Service waives any of the requirements of this section due to unique or unusual circumstances, a construction permittee shall be required to submit a written construction schedule to the City ten (10 working days before commencing any work in or about the rights of way and, shall further notify the City not less than two (2) working days in advance of any excavation in the rights of way. This section shall apply to all situations with the

exception of circumstances under Section 907.20.4.1of the City's codified ordinances (emergency situations).

1.6.2.E. Location of Facilities

1. The placement of new facilities and replacement of old facilities, either above ground or underground, shall be completed in conformity with applicable laws.
2. The City shall have the power to prohibit or limit the placement of new or additional facilities within the rights of way if the right of way is full. In making such decisions, the City shall strive to the extent possible to accommodate all existing and potential users of the rights of way but shall be guided primarily by considerations of the public health, safety, and welfare, the condition of the rights of way, the time of year, the protection of existing facilities in the right of way, future City and County plans for public improvements, development projects which have been determined to be in the public interest, and the non-discriminatory and competitively neutral treatment of providers.
3. Upon the concurrence of the City, or if it is determined by the construction permittee and any appropriate local, state, or federal agency (or other entity with jurisdictional authority) that an existing poles in the rights of way are full, then those poles may be replaced with bigger and/or taller poles in order to accommodate additional facilities or systems only after the construction permittee has made reasonable attempts to reach an acceptable solution without replacement with bigger and/or taller poles. This paragraph shall not apply to replacement of any existing pole(s) with identically sized pole(s) that results from the destruction of or hazardous condition of the existing pole(s) as long as no new facilities or additional facilities are attached.

1.6.2.F. Least Disruptive Technology

All construction or maintenance of facilities shall be accomplished in the manner resulting in the least amount of damage and disruption of the rights of way. In addition, all cable, wire or fiber optic cable installed in the subsurface rights of way under this chapter may be required to be installed in conduit, and if so required, no cable, wire or fiber optic cable may be installed under this chapter using "direct bury" techniques.

1.6.2.G. Relocation of Facilities

1. A provider shall, at its own expense, permanently remove and relocate its facilities in the rights of way whenever the City finds it necessary to request such removal and relocation. In instances where the City requests removal and/or relocation, the City shall waive all applicable construction permit fees. Upon removal and/or relocation, the provider shall restore the right of way to a condition at least as good as its condition immediately prior to said removal or relocation. If existing poles are required to be removed and/or relocated, then the existing poles will be replaced with reasonably obtainable poles of the same or similar size unless otherwise permitted by the City. The Director of Public Service may request relocation and/or removal in order to prevent unreasonable interference by the provider's facilities with:

    a. A public improvement undertaken or approved by the City or County;

    b. When the public health, safety, and welfare requires it, or when necessary to prevent interference with the safety and convenience of ordinary travel over the rights of way.

2. Notwithstanding the foregoing, a provider who has facilities in the right of way subject to a vacation or narrowing that is not required for the purposes of the City, shall have a permanent easement in such vacated portion or excess portion.

3. If, in the reasonable judgment of the City, a provider fails to commence the removal process and/or relocation of its facilities as designated by the City, within thirty (30) days after the City's removal order is served upon provider, or if a provider fails to substantially complete such removal, including all associated repair of the rights of way of the City, within twelve (12) months thereafter, then, to the extent not inconsistent with applicable law, the City shall have the right to:

    a. Declare that all rights, title and interest to the facilities belong to the City with all rights of ownership, including, but not limited to, the right to connect and use the facilities or to effect transfer of all right, title and interest in the facilities to another person for operation; or

    b. Authorize removal of the facilities installed by the provider in, on, over or under the rights of way of the City at provider's cost and expense, by another person, however the City shall have no liability for any damage caused by such action and the provider shall be liable to the City for all reasonable costs incurred by the City in such action; and

    c. To the extent consistent with applicable law, any portion of the provider's facilities in, on, over or under the rights of way of the City designated by the City for removal and not timely removed by the provider shall belong to and become the property of the City without payment to the provider, and the provider shall execute and deliver such documents, as the City shall request, in form and substance acceptable to the City, to evidence such ownership by the City.

1.6.2.H. Pre-Excavation Facilities Location

Before the start date of any rights of way excavation, each provider who has facilities located in the area to be excavated shall be responsible to mark the horizontal and make every reasonable attempt using best efforts, to mark the approximate vertical placement of all its facilities. All providers shall notify and work closely with the excavation contractor in an effort to establish the exact location of its facilities and the best procedure for excavation.

1.6.2.I. Rights of Way Restoration

1. The work to be done under the permit, and the restoration of the rights of way as required herein, must be completed within the dates specified in the permit. In addition to its own work, the permittee must restore the general area of the work, and the surrounding areas, including trench backfill, paving and its foundations in accordance with the standards established by the Director of Public Service, subject to any applicable laws. The permittee must also inspect the area of the work and use reasonable care to maintain the same condition for twelve (12) months thereafter.

2. In approving an application for a permit, the City may choose either to have the permittee restore the rights of way or the City may restore the rights of way itself at the expense of the permittee.

3. If the City chooses to allow permittee to restore the rights of way, construction permittee shall at the time of application of a construction permit post a construction bond in an amount determined by the City to be sufficient to cover the cost of restoring the rights of way to a condition at least as good as its condition immediately prior to construction. If, twelve (12) months after completion of the restoration of the rights of way, the City determines that the rights of way have been properly restored, the surety on the construction bond shall be released.

4. The permittee shall perform the work according to the standards and with the materials specified and approved by the City.

5. By restoring the rights of way itself, the permittee guarantees its work and shall maintain it for twelve (12) months following its completion. During this twelve (12) month period, it shall, upon notification from the Director of Public Service, correct all restoration work to the extent necessary using the method required by the Director of Public Service. Weather permitting, said work shall be completed within five (5) calendar days of the receipt of the notice from the Director of Public Service.

6. If the permittee fails to restore the rights of way in the manner and to the condition required by the City, or fails to satisfactorily and timely complete all repairs required by the City, the City, at its option, with notice to provider and a reasonable time to cure, may do such work. In that event, the permittee shall pay to the City, within thirty (30) days of billing, the cost of restoring the rights of way and any other costs incurred by the City. Upon failure to pay, the City may call upon any bond or letter of credit posted by the permittee and/or pursue any and all legal and equitable remedies.

1.6.2.J. Damage to Provider's Facilities and to Other Facilities

1. In the case of an emergency, and if possible after reasonable efforts to contact the provider seeking a timely response, when the City performs work in the rights of way and finds it necessary to maintain, support, or move a provider's facilities to protect those facilities, the costs associated therewith will be billed to that provider and shall be paid within thirty (30) days from the date of billing. Upon failure to pay, the City may pursue all legal and equitable remedies in the event a provider does not pay or the City may call upon any bond or letter of credit posted by permittee and pursue any and all legal or equitable remedies.

2. Each provider shall be responsible for the cost of repairing any facilities in the rights of way that it or its facilities damage. Each provider shall be responsible for the cost of repairing any damage to the facilities of another provider caused during the City's response to an emergency caused by such provider's facilities.

1.6.2.K. Rights of Way Vacation

If the City vacates a rights of way which contains the facilities of a provider, such vacation shall be subject to the provisions of O.R.C. § 723.04.01.

1.6.2.L. Installation Requirements

The excavation, backfilling, restoration, and all other work performed in the rights of way shall be performed in conformance with all applicable laws and the standards as promulgated by the Director of Public Service.

1.6.2.M. Inspection

1. When the construction under any permit hereunder is completed, the permittee shall notify the Director of Public Service.

2. The permittee shall make the construction site available to the Inspector and to all others as authorized by law for inspection at all reasonable times during the execution and upon completion of the construction.

3. At any time, including the time of inspection, the Inspector may order the immediate cessation of any work which poses a serious threat to the health, safety, or welfare of the public, violates any law, or which violates the terms and conditions of the permit and/or this chapter.

4. The Inspector may issue an order to correct work that does not conform to the permit and/or applicable standards, conditions or codes. The order shall state that failure to correct the violation will be cause for revocation of the permit. The order may be served on the permittee as provided in section 907.23.4 of the City's codified ordinances. An order may be appealed to the Director of Public Service. The decision of the Director of Public Service may be appealed to the Mayor whose decision shall be final. If not appealed, within ten (10) days after issuance of the order, the provider shall present proof to the Director of Public Service that the violation has been corrected. If such proof has not been presented within the required time, the Director of Public Service may revoke the permit pursuant to section 907.20.5 of the City's codified ordinances.

1.6.2.N. Other Obligations

Obtaining a construction permit does not relieve permittee of its duty to obtain all other necessary permits, licenses, and authority and to pay all fees, including onsite inspection fees, required by the City, or any other city, county, state, or federal laws.

1. A permittee shall comply with all requirements of laws, including the requirements of the Ohio Utility Protection Service (OUPS) and/or its lawful successor.

2. A permittee shall perform all work in conformance with all applicable laws and standards and is responsible for all work done in the rights of way pursuant to its permit, regardless of who performs the work.

3. No rights of way obstruction or excavation may be performed when seasonally prohibited or when conditions are unreasonable for such work, except in the case of an emergency as outlined in section 907.20.4.1 of the City's codified ordinances.

4. A permittee shall not so obstruct rights of way that the natural free and clear passage of water through the gutters or other waterways shall be interfered with.

5. Private vehicles other than necessary construction vehicles may not be parked within or adjacent to a permit area. The loading or unloading of trucks adjacent to a permit area is prohibited unless specifically authorized by the permit.

1.6.2.O. Undergrounding Required

Any owner of property abutting upon a street or alley where service facilities are now located underground and where the service connection is at the property line, shall install or cause others to install underground any service delivery infrastructure from the property line to the buildings or other structures on such property to which such service is supplied.

1.6.3 Minor Maintenance Permits

1.6.3.A. Minor Maintenance Permit Requirement

No person shall perform minor maintenance of facilities in the rights of way without first having obtained a minor maintenance permit as set forth in this chapter. Minor maintenance means: (i) the routine repair or replacement of facilities with like facilities not involving construction and not requiring traffic control for more than two (2) hours at any one location; (ii) or the routine repair or replacement of facilities with like facilities not involving construction and taking place on thoroughfares and arteries between the hours of 9:00 a.m. and 3:00 p.m.; (iii) or the routine repair or replacement of facilities with like facilities not involving construction on all rights of ways, other than thoroughfares and arterials, that does not impede traffic and is for a period of less than eight (8) contiguous hours; (iv) or construction other than on thoroughfares and arterials that takes less than eight (8) continuous hours to complete, does not impede traffic and does not involve a pavement cut.

1. A minor maintenance permit allows the minor maintenance permittee to perform all minor maintenance in any part of the rights of way as required.

2. A minor maintenance permit is valid from the date of issuance until December 31 of the year in which the minor maintenance permit was issued at which time the minor maintenance permit shall expire.

3. A minor maintenance permit must be displayed or upon request produced within twelve (12) business hours.

4. A minor maintenance permit by itself shall under no circumstances provide a permittee with the ability to cut pavement without seeking additional authority from the Director of Public Service.

1.6.3.B. Minor Maintenance Permit Applications

Application for a minor maintenance permit shall be made to the Director of Public Service. In addition to any information required by the Director of Public Service, all minor maintenance permit applications shall contain, and will only be considered complete upon compliance with the following provisions:

1. Credible evidence that the applicant has obtained a certificate of registration or proof that the applicant has written authority to apply for a minor maintenance permit on behalf of a party that has been issued a certificate of registration;

2. Submission of a completed minor maintenance permit application in the form required by the Director of Public Service.

3. A statement that the applicant will employ protective measures and devices that, consistent with the Ohio Manual of Uniform Traffic Control Devices, will prevent injury or damage to persons or property and to minimize disruptions to the efficient movement of pedestrian and vehicular traffic.

1.6.3.C. Issuance of Minor Maintenance Permits: Conditions

1. If the Director of Public Service determines that the applicant has satisfied the requirements of this chapter and the minor maintenance permit process, the Director of Public Service shall issue a minor maintenance permit subject to the provisions of this chapter.

2. The City may impose reasonable conditions, in addition to the rules and regulations enacted by the Director of Public Service, upon the issuance of the minor maintenance permit and the performance of the minor maintenance permittee thereunder in order to protect the public health, safety, and welfare, to ensure the structural integrity of the rights of way, to protect the property and safety of other users of the rights of way, and to minimize the disruption and inconvenience to the traveling public.

1.6.3.D. Minor Maintenance Permit Fees

The Director of Public Service shall, after providing notice to and seeking input from all providers with systems in the City right of way, develop and maintain a schedule of permit fees in an amount sufficient to recoup all reasonable costs associated with processing minor maintenance permits, as allowed by law. See Chapter 190 of the City's codified ordinances for fee. No minor maintenance permit shall be issued without payment of minor maintenance permit fees except to the City or County, which shall be exempt. Minor maintenance permit fees that were paid for a minor maintenance permit that the City has revoked due to breach are not refundable. The Director of Public Service may revoke the minor maintenance permit as any other permit may be revoked under this chapter.

Chapter 2: Development Procedures & Submittal Requirements

2.1 Introduction

The purpose of this chapter is to provide an overview of the Engineering Division submittals required as part of the development process. The submittals include a Transportation Impact Study (TIS), which is submitted prior to development approval, and a plat, which is submitted after development approval.

The *Guidelines for the Preparation of Transportation Impact Studies (Guidelines)* is a reference document describing the City of Hilliard requirements and methodologies for assessing and mitigating the transportation impacts associated with applications for property development in the City. The *Guidelines* supersede the *Applicant's Guide for Traffic Access and Impact Studies for Proposed Development (January 2001).* It reflects current City transportation goals and incorporates the latest methodologies, practices, and tools to analyze transportation impacts at City intersections and within its corridors. The *Guidelines* will be reviewed and updated periodically to reflect changes in City policy and development review and approval practice. A copy of the most recent version of the Guidelines can be obtained online at: www.hilliardohio.gov/. An overview of the TIS requirements is provided in section 2.2.

The procedure for plat approval is described in section 2.3.

2.2 Transportation Impact Study

A Transportation Impact Study (TIS) is a valuable source of information for officials responsible for reviewing development applications. Not only does a TIS determine and evaluate the effects of a proposed development on the surrounding transportation system, it suggests infrastructure improvements and other mitigating measures necessary to accommodate travel generated by the development.

The City of Hilliard Comprehensive Plan establishes overlying principles pertaining to transportation and development that change the way in which transportation impacts are evaluated. Traditional TISs of the past focused primarily on resolving congestion by widening roadways to increase vehicular capacity. This auto-centric approach tends to result in over widening of roadways to meet peak hour vehicle demand at the expense of community character, livability, and the needs of non-motorized users. The adoption of the Hilliard Comprehensive Plan and the corresponding Thoroughfare Plan and Access Management Plan in 2011 has prompted the need to update TIS requirements to meet new community goals. Today's TIS focuses more on accommodations to support and encourage a safe and efficient active transportation system, focusing more on the needs of pedestrians, cyclists, and transit users.

While transportation objectives and policies are the primary focus of a TIS, the broader Comprehensive Plan goals integral to the creation of a strong city should be kept in mind. These include developing a livable and sustainable suburban area, promoting a fiscally-responsible approach to development, having regard for environmental health, and generally enhancing social wellbeing by providing a balanced transportation system that is supportive of vehicles, pedestrians, bicyclists, and transit users.

2.2.1 Purpose of a TIS

A TIS is intended to provide the information necessary to guide City staff in reviewing the transportation aspects of the development proposal by:

- Accessing the extent of transportation impacts;
- Evaluating how the development meets the provisions of the City of Hilliard Thoroughfare Plan and the Access Management Plan;
- Identifying physical infrastructure improvements that should be considered either on opening day or upon full build out of the development to ensure network safety and acceptable operating conditions for motorized and non-motorized users on streets, sidewalks, pathways, pedestrian crossings, and access points;
- Determining if the physical infrastructure improvements are consistent with Hilliard Comprehensive Plan objectives, particularly in the four Focus Areas;
- Determining if the physical infrastructure improvements are reasonable based on planned Capital Improvement Projects in the area;
- Identifying appropriate travel demand management (TDM) strategies to reduce private motor vehicle use and encourage pedestrian and bicycling; and
- Maintaining consistency with other City transportation objectives and policies.

2.2.2 When a TIS is Required

In most cases, a TIS is required when a proposed development meets one or more of the following criteria:

- **Significantly-Sized Project.** The development generates more than 100 vehicle trips per hour of an average day based on ITE trip generation rates or site-specific traffic data previously obtained at a similar location (subject to the approval of City staff).
- **Nearby Congestion.** Vehicle traffic generated by the development is expected to trigger a critical capacity or safety condition at one or more of the surrounding signalized intersections as defined by:
    - Volume to capacity ratio of 1.0 or greater
    - Vehicle level of service greater than "E" for any approach
    - Vehicle queuing at through or turn lanes, which impacts the ability to enter or exit the development or existing driveways located opposite the development
- **Change in Access.** The development proposal incorporates a change in access to a street listed in the Hilliard Thoroughfare Plan.
- **Change in Site Circulation.** The development proposal incorporates a change in the site layout that results in traffic pattern changes on the site that would impact operations on the public street. Examples include changes to drive-thru window locations or major drive aisle locations.
- **Change in current land use which encourages street crossing**. The development proposal changes the land use to a use that is complimentary to a use located across a street listed on the Hilliard Thoroughfare Plan, prompting the need to evaluate pedestrian crossing accommodations. Examples include residential/school, residential/neighborhood retail, and office/restaurant.
- **Growth Corridor Location**. The development proposal is located in an area that is expected to experience significant growth. Coordination with other development proposals within the larger area is critical to plan driveway locations, cross access points, and corridor-wide streets and bike/ped improvements.

Many factors impact the size and scope of a TIS. In some cases a smaller traffic operations analysis or an update to an existing study may be all that is necessary. If a developer proposes a change in existing land use or zoning that results in fewer vehicle trips generated on the site and the development proposal does not adversely impact the accommodations for non-motorized users, the TIS requirement may be waived by the City; documentation must be provided in letter format by the developer's engineer that supports the claim that the proposed use or zoning is a less intense land use. The applicant should consult with staff to determine the level of analysis that is required.

If a TIS, or a less detailed analysis based on the nature of the development proposal, is required, it should be submitted at the following times to allow for appropriate review and comment by staff:

- Included with a Planning & Zoning Commission or Board of Zoning Appeals application. Examples include:
  - Rezoning
  - Zoning modification
  - Conditional use
  - Final development plan
  - Level "B" site plan review

- Included with submittals that require staff-level approval. Examples include:
  - Level "A" site plan review
  - Zoning certificate
  - Building permit

Failure to submit a TIS or an appropriate traffic operations analysis in a timely manner could result in delay of approval or issuance of building permits. Early staff consultation is recommended for all development or redevelopment proposals that meet one of the above criteria.

2.2.3 Staff Consultation

Developers who are required to complete a TIS are strongly encouraged to consult with the appropriate staff from the City of Hilliard and/or other government agencies early in the application process. Benefits of pre-consultation include:

- **Identifying transportation issues** that may affect the land use, density, site plan, building placement, access location, or other area-specific issues before a high level of effort is expended by the developer;
- **Confirming the TIS scope** to ensure a complete submission concurrent with the development application;
- **Assessing the need for additional meetings** with City Planning staff and/or other agencies for information gathering and/or coordination.

2.2.4 Key TIS Elements

A TIS generally contains the elements listed below. Each of these components is addressed in detail in the *Guidelines*.

- Define the development proposal (land use & site layout)
- Compare development proposal to the Hilliard Thoroughfare Plan and Access Management Plan
- Define the study area and study intersections
- Determine analysis years, background traffic conditions, and appropriate growth rates
- Determine site-generated traffic, trip distribution, and project phasing (if applicable)
- Identify Travel Demand Management (TDM) strategies and establish any trip reductions
- Analyze vehicle level of service, intersection capacity, vehicle queuing, turn lane storage requirements, sight distance at intersections, signal warrant or roundabout feasibility, and pedestrian & bicycle mobility and safety
- Evaluate the adequacy of the existing infrastructure, such as street width, shoulder width, and pavement condition, to support the proposed development
- Propose improvements to mitigate impacts to streets, sidewalks, multiuse paths, or on-street bicycle facilities
- Propose improvements to pedestrian and bicycle accommodations, including crossings of all Thoroughfare Plan streets in a safe and convenient way, and identify ways to connect the development to Hilliard's regional trail infrastructure
- Evaluate how mitigation strategies adhere to the principles of the Hilliard Comprehensive Plan

2.3 Procedure for Plat Approval

2.3.1 Conditional Approval of Preliminary Plat

2.3.1.1 Contents and Supplementary Information

1. The preliminary plat shall be clearly and legibly drawn. The size of the map shall be on one or more sheets twenty-four by thirty-six inches, or thirty-six by forty-two inches. All subdivisions of six acres or less shall be drawn at a scale of one inch equals fifty feet. All subdivisions of over six acres shall be drawn at a scale of one inch equals 100 feet.
2. The preliminary plat shall contain the following information:
    a. Proposed name of the subdivision. The name shall not duplicate, be the same in spelling, or be alike in pronunciation with any other recorded subdivision of Franklin County;
    b. Location by section and township;
    c. Names and addresses of the subdivider, owner and professional individual responsible for the preparation of the preliminary plan;
    d. Date of survey;
    e. Scale of the plan both graphically and numerically, north point and date;
    f. Boundaries of the subdivision indicated by a heavy line and its acreage indicated;
    g. Total acreage;
    h. Location, widths and names of existing, platted streets, railroad rights-of-way, easements, parks, permanent buildings and corporation lines, township and county;

i. Names of adjacent subdivisions, owners of record of adjoining parcels of unsubdivided land as of the last preceding tax roll, and the location of their boundary lines;
j. Zoning districts;
k. Existing drainage channels, underground facilities, wooded areas, power transmission poles and lines, bearings of alignment, and any other significant items;
l. All lot numbers and building setback lines with dimensions;
m. When lots are located on a curve or when side lot lines are at angles other than ninety degrees, the width at the building line;
n. Parcels of land intended to be reserved for public uses or to be reserved by covenant for residents inhabiting the subdivision;
o. Vicinity map; and
p. Proposed street names that do not duplicate names of recorded City streets in Franklin County.

3. Supplementary information: The statement of the proposed use of lots, stating the type of residential buildings with the number of proposed dwelling units and the type of business or industry, so as to reveal the effect of the development on traffic, fire hazards or congestion of population, shall contain:
    a. Proposed covenants and restrictions;
    b. Evidence of an adequate water supply;
    c. A statement outlining the method to be used and provisions to be made for sewage disposal, drainage and flood control; and
    d. If any zoning changes are contemplated by the subdivider, the proposed zoning should be outlined and described.
4. After receiving notice of the approval of the preliminary plat or plan and prior to filing of the final plat, the subdivider shall present to the Planning and Zoning Commission typical sections and complete location and size of streets, sanitary sewers, storm sewers, water lines, profiles and other related improvements to be constructed in the proposed subdivision prepared by a registered engineer. The Commission shall, within five working days after the filing of the above typical sections and complete profiles, transmit copies of these to the City Engineer and the City or County Sanitary Engineer for study and final recommendations. The Commission, after receiving a report from these officials, shall notify the subdivider of any recommended changes or suggestions so that the subdivider may prepare the final improvement plans and final plat.
    a. Presentation: The subdivider shall prepare a preliminary plan and present it to the Commission, and five copies shall be required by the Commission according to the standards and other requirements of these regulations.
    b. Approval: The Commission shall act on the preliminary plan within sixty days after filing unless such time is extended by agreement with the subdivider or his agent.

2.3.1.2 Approval of the preliminary plan shall confer upon the subdivider, for one calendar year from the date of approval, a guarantee that the general terms and conditions under which the approval was granted shall not be affected by any changes or amendments to these Subdivision Regulations.

2.3.2 Approval of Final Plat

2.3.2.1 General: The final plat shall have incorporated all changes or modifications required by the City Planning and Zoning Commission and City Engineer. Otherwise, the final plat shall conform to the preliminary plat, and it may constitute only that portion of the approved preliminary plat which the subdivider proposed to record and develop at the time, provided that such portion conforms with all requirements of these regulations.

2.3.2.2 Preparation: The final plat shall be prepared by a registered surveyor.

2.3.2.3 Form: The final plat shall be clearly and legibly drawn in India ink on tracing cloth or other materials of equal permanence. The size of the plat shall be on one or more sheets twenty-four by thirty-six inches, or thirty-six by forty-two inches. Scale shall be one inch equals fifty feet. If more than two sheets are required, an index sheet shall be filed showing the entire subdivision on one sheet with all areas shown on other sheets indicated thereon.

2.3.2.4 Map Contents: The final plat shall contain the following information:

a. Name of subdivision, location by date, north point, graphic and numerical scale, and total acreage. The north point shall be indicated on each page of a plat.

b. All plat boundaries with length of courses in feet and hundredths, bearings to not more than half minutes. Closure shall be submitted to second order survey.

c. Bearings and distances to the nearest established street lines or other recognized permanent monuments shall be accurately described on the plat.

d. Lines of adjoining streets and alleys with their widths and names plus building setback lines.

e. The radii, area, chords and chord bearings, points of tangency, and general angles for all curvilinear streets and radii for rounded corners.

f. All easements and rights-of-way provided for public services or utilities, and any limitations of such rights-of-way or easement.

g. All lot numbers and lines, with accurate dimensions in feet and hundredths, and with bearings. The basis of bearings shall be stated on the plat. The acreage of all lots over one acre in size shall be indicated.

h. Accurate location and description of all monuments.

i. Names and addresses of the subdivider and the qualified surveyor who prepared the final plan.

j. Accurate outlines of any areas to be dedicated or temporarily reserved for public use with the purpose indicated thereon.

k. A list of all covenants and restrictions, if any, the developer intends to include in the deeds to the lots in the subdivision.

l. Certification by a registered surveyor to the effect that the plan represents a survey made by him and that all monuments shown thereon actually exist and that their location is correctly shown.

m. An acknowledgement by the owner or owners of his or their adoption of the plat, the dedication of streets and other public areas.

n. Vicinity map of area within one-half mile radius.

2.3.2.5 Supplementary Information:

1. If a zoning change is involved, certification from the City Clerk shall be required indicating that the change has been approved and is in effect.

2. The final plan shall be accompanied by certificates showing the following:

   a. That all legally due taxes have been paid; and

   b. That all improvements have either been installed and approved by the proper officials or agencies or that a bond or other security has been furnished assuming installation of the required improvements.

2.3.2.6 Plan and Profile. A plan view of the streets shall be drawn to a scale of one inch equals fifty feet, one inch equals eighty feet, or one inch equals 100 feet. The scale of one inch equals 100 feet shall be used only with the approval of the City Engineer or his representative in advance of the final preparation. The plan view shall show the proposed road, street or alley alignment, right-of-way and pavement widths, centerlines, bearings, stationing, curve or radius data, and existing and proposed drainage. Any other significant feature or factor shall also be shown on the plan. The centerline of road, street, or alley construction shall coincide with the centerline of the right-of-way. Any changes in these requirements shall be at the discretion of the City Engineer or his representative.

2.3.2.7 Filing:

1. The final map shall be filed with the Commission not later than twelve months after the date of approval of the preliminary plan. Otherwise, the final map shall be considered void unless an extension is requested by the developer and granted by the Commission in writing.

2. The final plan shall be considered officially filed after it is examined by the City Engineer and found to be in full compliance with the formal provisions of these regulations. The final plan shall be filed at least ten working days prior to the meeting at which it is to be considered.

3. The developer shall submit a statement of the proposed use of lots, stating the type of residential buildings with the number of proposed dwelling units, the type of business or industry, so that the effect of the development of traffic, fire hazards or congestion of population can be determined, and the source of water supply, provisions for sewage disposal, drainage and flood control.

2.3.2.8 Approval:

1. The Commission shall take action on the final plat within sixty days after the plat has been officially filed with it. Otherwise, the plat shall be deemed to have been approved. The certificate of the Commission as to the date of the submission of the plat for approval, and the failure to take action within such time, shall be sufficient in lieu of the written endorsement or evidence of approval herein required. In unusual circumstances where the safety, health and welfare of the City or community may be jeopardized by the approval of the proposed plat, the Commission may disapprove the plat. If a plat is disapproved for any reason, the grounds for disapproval of the final plat shall be stated on the record of the Commission, including the reference to the regulation violated by the plat, and a copy of the record of the Commission shall be forwarded to the subdivider. The subdivider shall make necessary corrections and resubmit the final plat within thirty days to the Commission for its approval.

2. The subdivider shall be notified of the final approval of the plat by the Commission.

2.3.2.9 Recording of the Final Plat: After the final plat has been approved by the Commission, the City Engineer, and the necessary approvals endorsed in writing thereon together with evidence of title, it may be filed for recording in the office of the Recorder of Franklin County, Ohio, as required by law.

2.3.3 Deed Transfers

Whenever any transfer is to be made of parcels as described in Section 1188-5(c) of the Planning and Zoning Code, the party or parties desiring to make the transfer shall submit a sketch thereof to the City Planning and Zoning Commission. If the division conforms to appropriate standards, the responsible official may stamp it "Approved, No Plat Required" and attach his signature, and the appropriate transfer may be recorded. However, if the owner of the property does not agree with any of the requirements specified by the Commission, he may then appeal to Council for approval for recording, and such approval shall be obtained before the transfer can be recorded. No preliminary or final plan, other than the rough sketch of the division shall be required for the transfer.

Chapter 3: Construction and Material Specifications

3.1 Construction and Material Specifications

A. The current edition and all supplemental specifications of the City of Columbus Construction and Material Specification (CMSC) shall govern all projects within the City of Hilliard's limits, unless funding is provided by the state. In this case the current edition and all supplemental specifications of ODOT CMS shall govern the projects.

The 100 Section of CMSC may be superseded by Hilliard's Construction Contract documents for Capital Improvement Projects.

B. When the City of Hilliard takes exception to or changes any provision of the CMSC or ODOT CMS it shall create a standalone supplemental specification that will be incorporated into final construction plans or documents.

100 General Provision of Columbus (CMSC) – noted exceptions

101.03 Definitions:

City – The City of Hilliard acting through its Director or properly authorized agents thereof, such agents acting severally within the scope of the particular duties entrusted to them.

Department – The department of the City of Hilliard under which the Project is being performed

Director – The Director of the City of Hilliard under which the Project is being funded or the department holding the Contract.

Engineer – The Engineer, Architect, Planner, or other authorized representative of the City of Hilliard working under supervision of the Director under which the project is being performed.

Owner – The Department of the City of Hilliard that invited Bids and is financially responsible for the Project.

Chapter 4: Roadway

4.1 Introduction

In 2010, the City of Hilliard partnered with Columbus Public Health and other local government, nonprofit, and business leaders to create the Franklin County Physical Activity Plan. This plan acknowledges that transportation, specifically a built environment that promotes *active* transportation such as walking and bicycling, is a key component in transforming communities into places that support healthy lifestyles and increase the opportunity for physical activity for all residents in their daily lives. The added benefit of increasing the opportunities to walk and bicycle is the potential for reduced automobile congestion, which impacts the livability and economic viability of the community. The City of Hilliard roadway standards provided herein encourage street connectivity and aim to create a comprehensive, integrated, and connected network for all modes of travel to promote active transportation, reduce congestion, and provide choices to residents that promote healthy living.

In 2011, the City of Hilliard adopted the Hilliard Comprehensive Plan (Ordinance 11-36). This plan evaluated the integral relationship between land use, transportation, public spaces, and economic development and establishes the vision and goals for the Hilliard of the future. Plan goals include:

- Become a better connected community
- Grow into a truly sustainable community
- Promote active and healthy lifestyles
- Define and reinforce the character of Hilliard
- Optimize development potential in ways that benefit current and future residents
- Collaborate with surrounding communities and local stakeholders

Roadway design has an impact on each of the above Plan goals, and recommendations of the Comprehensive Plan include specific action items that pertain to the way in which roadways are designed and policies that govern the way in which our roadways are used to achieve those goals.

In 2012, the City of Hilliard adopted a Complete Streets Policy (Resolution 12-R-14), which recognizes the need to accommodate all users within the public right-of-way and to provide adequate connections between the public right-of-way and private property. "All users" includes pedestrians, bicyclists, and transit passengers of all ages and abilities, as well as trucks, buses, and automobiles. Though the intent of the City of Hilliard roadway standards is to be context sensitive for any given type of roadway, the needs of *all* users shall be considered and factored into the planning, design, maintenance, and operations of all roadway systems.

This chapter establishes design criteria required for roadways, intersection control, and access management within the City of Hilliard that support the goals and objectives of the Hilliard Comprehensive Plan.

4.2 Roadway Planning

4.2.1 Roadway Functional Classification

All roadways within the City of Hilliard are classified based upon the following descriptions, and each roadway is assigned a functional classification. The design criteria and goals for a given roadway are based on this functional classification.

4.2.1.A Major Arterial

Major arterial roadways serve the major activity centers, the highest traffic volume corridors, and the longest trips. Service to abutting land should be subordinate to travel service. This system carries the major portion of trips entering and leaving an urban area as well as the majority of through movements desiring to bypass the area. Major arterials range from interstates/freeways to principal streets and highways.

4.2.1.B Minor Arterial

Minor arterial streets and highways interconnect with and augment the major arterial system and provide service to trips of moderate length at a somewhat lower level of travel mobility. This system places more emphasis on land access and distributes travel to geographic areas smaller than those identified with the major arterial system.

4.2.1.C Network Collector

Network collector streets penetrate development subareas and neighborhoods, collect traffic from local streets and channel it into the arterial systems. A minor amount of through traffic may be carried on collector streets, but the system primarily provides land access service and carries local traffic movements within residential, commercial, and industrial areas.

4.2.1.D Local Street

Local streets are not those classified in another system and primarily provide direct access to abutting land and access to the other systems. They offer the lowest level of mobility, and service to through traffic should be deliberately discouraged.

4.2.2 Right of Way Requirements

The right-of-way widths for subdivision and thoroughfare roadways are based on typical cross-section needs beyond the actual travel way. See cross sections and charts throughout this chapter for details.

4.2.3 Block Lengths

Block Lengths are encouraged to be 400 to 550 feet between pedestrian and/or vehicular connections, encourage rear access along the Thoroughfare Plan streets, provide access to desirable amenities and public spaces, and ensure sufficient connectivity to adjacent development. Such connections should provide direct paths between both residential and commercial uses, and complementary uses such as retail and recreational uses.

4.2.4 Streets Within (Re)Developments

The City of Hilliard encourages the development of a grid-style network. Multiple connections on all sides of new developments should be considered. Large housing developments should provide multiple connections to adjacent neighborhoods and major streets, reducing congestion and through traffic on all streets within the development. Stub streets and paths in adjacent developments should be connected to the new development. Where the adjacent property has (re)development potential, stub streets should be built to facilitate new connections in the future. Pedestrian/bike connections should be made between neighborhoods and residential and non-residential properties. Culs-de-sac and dead-end streets are not permitted within the City of Hilliard. Developers should require special permission from the City Engineer to include culs-de-sac and dead-end streets where necessary in their subdivisions.

4.3 Thoroughfare Plan Streets

4.3.1 Applicability. Roadways that are listed on the Hilliard Thoroughfare Plan include major arterials, minor arterials and network collector streets. These types of roadways place a higher priority on movement of all modes of traffic along the corridors with less emphasis placed on access to individual properties, especially in close proximity to major intersections where queues in traffic are common.

4.3.2 Exceptions. Main Street, Center Street, and Norwich Street in Old Hilliard, while listed in the Hilliard Thoroughfare Plan, are unique roadways because of the surrounding land use and density. Specific roadway design guidance and standards, which are more appropriate for a downtown district, are provided in Section 4.6.

4.3.3 Planning and Design Goals. Goals for planning and designing Thoroughfare Plan streets include movement of motorized and non-motorized traffic in a harmonious manner, minimizing direct access to individual properties, and balancing the sometimes competing needs of large motorized users (trucks, buses, and emergency vehicles), small motorized users (cars and motorcycles), and non-motorized users (pedestrians and bicyclists).

4.3.4 Roadway Characteristics. Table 1 of the Hilliard Thoroughfare Plan establishes the number of vehicle lanes, pedestrian and bicycle facilities, design designation, level of access control, and right-of-way widths for all Thoroughfare Plan streets. Typical sections shown in Figure 2 of the Hilliard Thoroughfare Plan provide details on minimum vehicle lane, median, tree lawn, and pedestrian/bicycle facility widths for each street.

4.3.5 Speed. The speed limits of roadways included in the Thoroughfare Plan within City of Hilliard jurisdictional boundaries are typically 35 mph to 45 mph. Roadways should be designed in a manner to achieve 85th percentile operating speeds consistent with the speed limit. Overdesign of roadways to obtain a "factor of safety" is discouraged because it tends to encourage faster speeds thereby defeating the intent of improving safety along a roadway. Vertical traffic calming measures are not appropriate along Thoroughfare Plan streets, but horizontal measures may be appropriate and effective at controlling speeds. Horizontal measures include installation of medians, narrowing vehicle lanes, reducing building setbacks in the built environment, and installation of street trees to calm traffic.

4.3.6 Pedestrian Facilities. Sidewalks (5' minimum width) and/or multi-use paths (8' minimum/10' recommended) are required on both sides of all Thoroughfare Plan streets. For corridors with few access points, multi-use paths are recommended on both sides of the street to better accommodate all non-motorized users. Engineering judgment should be used to determine the appropriate pedestrian accommodation based on vehicle and pedestrian volume, adjacent land use, available right-of-way, and future conditions.

4.3.7 Bicycle Facilities. On Thoroughfare Plan streets, it is important to provide bicycle facilities to accommodate less confident users separated from vehicular traffic as well provide horizontal space on the street so that more confident, faster-moving bicyclists can use the roadway without negatively impeding vehicular traffic. Slower or casual bicyclists (children, families, seniors) may be accommodated through the use of multi-use paths (8' minimum/10' recommended) that run parallel to the street and separated from traffic by a tree lawn or another buffered area. These paths are typically shared with pedestrians. Faster or more confident bicyclists (commuters, experienced adults, fitness enthusiasts) may be accommodated through the use of bike lanes, paved shoulders, or wider outside vehicle lanes. Engineering judgment should be used to determine the

appropriate bicycle accommodation based on vehicle and pedestrian volume, vehicle speed, adjacent land use, available right-of-way, and future conditions.

4.3.8 Sidewalk and Multi-use Path Crossing of a Public Street. Pedestrians and bicyclists are legitimate users of the transportation system, and they should, therefore, be able to use this system safely and without unreasonable delay. Pedestrians and bicyclists have a right to cross roads safely, and planners and engineers have a professional responsibility to plan, design, and install safe and convenient crossing facilities. Pedestrians and bicyclists should be included as design users for all city streets. Where a sidewalk or multi-use path crosses a public street, the crossing of the stop or signal-controlled side street shall be in a manner that maintains the alignment of the ramp and marked or unmarked crosswalk with the approaching sidewalk or path that runs parallel to the main street, keeping the crosswalk in front of stopped vehicles on the side street and providing better visibility of pedestrians for vehicles turning from the main street to the side street at the intersection. The crossing of the main street shall be clearly defined and marked at a traffic signal or a roundabout. The crossing of the main street at an uncontrolled location, such as at an unsignalized intersection or midblock crossing, shall be evaluated on a case-by-case basis taking vehicular volume, speed, number of lanes, and visibility into consideration. Engineering judgment shall be used in establishing mid-block crossings that are not legal crossings absent of a marked crosswalk.

4.3.9 On-Street Parking. On-street parking is prohibited on major and minor arterial streets listed in Thoroughfare Plan outside the Old Hilliard District. On-street parking may be permitted on lower volume network collector streets where homes front directly onto the street provided that sufficient roadway width is available. In new development, any homes that front onto a network collector street shall be built with consolidated driveways that provide for on-street parking on parallel access drives. In situations where neighborhood-serving non-residential uses (schools, community centers, public or private recreational facilities or neighborhood retail) are located along network collector streets, it may be appropriate to provide on-street parking to supplement off-street parking that is provided on the site. Engineering judgment should be used to determine the appropriate location of on-street parking on network collector streets based on land use, building setbacks, pedestrian/bicycle accommodations, and vehicle speeds.

4.3.10 Buffer Zone. A buffer zone is the area between the back of the curb (or vehicular travel lane if uncurbed) and the off-street pedestrian/bicycle facility. A buffer zone may be referred to as a "tree lawn" and includes space for public signs, street lights, street furniture, transit stops, utilities, trees, and other landscaping elements. Buffer zones not only provide space for necessary roadside elements, but they also provide a barrier between pedestrians and vehicular traffic. This area provides the space for curb ramps, which pedestrians can use to transition from the sidewalk to the street. Buffer zones vary in width depending on the type and size of contents within the buffer zone. In order to provide curb ramps without altering the typical elevation of the adjacent sidewalk or multi-use path, the minimum width of the buffer zone is eight (8) feet. A wider tree lawn may be appropriate in a high-volume pedestrian environment, a higher-speed vehicular environment, or in locations where larger street trees will be used.

4.3.11 Street Trees. The benefits of street trees in an urban and suburban environment are numerous and well documented. Not only do street trees provide beauty, shade, and environmental benefits, but a well-designed street tree planting arrangement also reduces vehicle speeds, creates a safer walking environment, provides for a vertical buffer along a street, and adds value to the homes and businesses along the street. In order to achieve these benefits, street trees must be selected and placed in a manner that is appropriate for the available space. Care should be taken to ensure that street trees and other landscaping

features do not block sight distance at intersections and driveways, do not block visibility of traffic control devices, and do not inhibit the illumination of the street or walks. It is also important to consider the available horizontal space within the buffer zone and the presence of aboveground or underground utilities that may be impacted by the tree or its roots as it grows. See Chapter 12 for additional details on street trees.

4.3.12 Access Management. Access management is critical on Thoroughfare Plan streets, particularly higher level major and minor arterials, in order to preserve the capacity of the roadway and improve safety. The City of Hilliard Access Management Plan, included as a technical appendix in the Thoroughfare Plan, shall govern the location and design of driveways. The level of access management is based on the access category of the street and the volume of traffic anticipated on the driveway. Special attention shall be taken to ensure that new driveways are placed outside the functional area of intersections.

4.3.13 Design Guidance. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, commonly referred to as the "Green Book," shall guide the design of all roadways within the City of Hilliard. In all cases, engineering judgment shall be used to determine an appropriate design speed, design vehicle, and other key design parameters to create a roadside environment that balances all users. In many cases the Ohio Department of Transportation provides appropriate design guidance. However, care should be taken to ensure that the particular guidance is appropriate for streets within a municipal corporation with slower speeds and higher emphasis on mobility and safety of more vulnerable road users.

4.3.13.A Horizontal, Vertical, and Geometric Design Guidance. The most current version of the Ohio Department of Transportation (ODOT) *Location and Design Manual* shall guide and govern the site distance, horizontal alignment, vertical alignment, and geometric design of all Thoroughfare Plan streets.

4.3.13.B Roundabout Design. The design of modern roundabouts shall be governed by the National Cooperative Highway Research Program (NCHRP) Report 672 *Roundabouts: An Informational Guide, Second Edition* or subsequent later editions. Roundabouts shall be evaluated for all new intersection improvements in the City of Hilliard unless the intersection is within a closed loop signal system.

4.3.13.C Pedestrian Facility Design. The design of pedestrian facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG). All public street intersections are legal pedestrian crossings. Safe and convenient pedestrian crossing of the public streets shall be considered at all times. Engineering judgment shall be used in the design of pedestrian crossings with particular attention made at uncontrolled locations, which may benefit from the installation of raised medians for pedestrian refuge or other high visibility treatments or enhancements to improve pedestrian safety. Volume and speed of vehicular traffic, volume of pedestrian traffic, and location of high pedestrian generating land uses shall be evaluated in determining the best crossing treatment at a given location.

4.3.13.D Bicycle Facility Design. The design of bicycle facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG), the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, and the National Association of City Transportation Officials (NATCO) *Urban Bikeway Design Guide*.

4.3.13.E Traffic Control Design. The location and design of all traffic control devices for all streets, highways, bikeways, and private roads open to public travel are governed by the most current version of the Ohio Department of Transportation (ODOT) *Ohio Manual of Uniform Traffic Control Devices* (OMUTCD) and supplemental City of Hilliard specifications.

4.3.13.F Street Lighting Design. For street lighting standards, see Chapter 10

4.4 Local (Residential) Streets

4.4.1 Applicability. Roadways that are not listed on the Hilliard Thoroughfare Plan are local streets. These types of roadways place a higher priority on access to individual properties and parking. Local streets include:

Neighborhood (subdivision) collector streets, which provide access to homes or neighborhood-serving non-residential uses (schools, community centers, public or private recreational facilities or neighborhood retail) and intersect with the higher level Thoroughfare Plan street network;

Neighborhood (subdivision) local streets, which provide access to homes and do not intersect with higher level Thoroughfare Plan street network; and

Lower-level commercial or industrial streets with the primary function of access to business or industry, not efficient movement of through traffic.

4.4.2 Planning and Design Goals. Goals for planning and designing local neighborhood streets include access to property, vehicle speed management, connectivity, walkability, bikeability, comfort, aesthetics, and parking availability. These goals are achieved through the use of narrower, shorter streets to discourage high speed and high vehicle volumes, providing multiple points of connectivity, and encouraging parking on both sides of the roadway. Local streets shall maintain an environment that supports the efficient, safe, and comfortable movement of people along the street network with a lesser emphasis on efficient movement of motorized vehicles. The local street network shall be planned and designed in a grid-style manner that provides access to the higher level Thoroughfare Plan street network through multiple connections, distributing traffic equally between streets without concentrating vehicular traffic on one or two streets within a neighborhood. In all cases, local streets, including pedestrian and bicycle facilities, shall be planned to connect to future neighborhoods in multiple locations. No local street shall connect to more than one higher level Thoroughfare Plan street. Local street designs that utilize culs-de-sac and loop streets or lack connectivity (current and future) are highly discouraged.

4.4.3 Roadway Characteristics. In order to achieve the planning and design goals for residential streets, the following guidance is provided for the street layout:

Maximum Street Length: 1,500’
Maximum Block Length: 500’

Street widths vary based on:

- Type of street (Local versus Neighborhood Collector);
- Average lot width; and
- Orientation of the home frontage

The tables below provide guidance on appropriate street widths based on the above parameters. The maximum street length and block length applies to both neighborhood local streets and neighborhood collector streets.

Neighborhood Local Street			
ROW Width	Avg. Lot Width	Street Width (f/f curb)	Tree Lawn Width
60’	>65’	26’	10.5’
70’	<65’	32’	12.5’

Neighborhood Collector Street			
With Home Frontage to Street			
ROW Width	Avg. Lot Width	Street Width (f/f curb)	Tree Lawn Width
60’	>75’	26’	10.5’
70’	60’ – 75’	32’	12.5’
70’	<60’	36’	10.5’
Without Home Frontage to Street (minimum parking demand)			
ROW Width	Avg. Lot Width	Street Width (f/f curb)	Tree Lawn Width (w/ 8’ path in lieu of walk)
70’	N/A	26’	12.5’

See the “Roadway Characteristics” exhibits in the appendix for more information on roadway characteristics for residential streets.

4.4.4 **Speed.** The speed limit on Local Streets is typically 25 mph. In predominantly industrial or commercial districts, the speed limit may be 35 mph as determined on a case-by-case basis with input from the Safety Department. Roadways shall be designed in a manner to achieve 85th percentile operating speeds consistent with the speed limit. Horizontal traffic calming elements may be incorporated into new Local Street designs, particularly those that exceed the maximum street length, to encourage slower vehicle speeds but not without first establishing a well-designed development layout with the roadway characteristics designated in Section 4.4.3. Examples of horizontal traffic calming measures include curb extensions at intersections and neighborhood traffic calming circles. Stop signs shall not be used for speed control.

4.4.5 **Pedestrian Facilities.** Sidewalks (5’ minimum width) are required on all Local Streets unless specifically waived for local streets in certain industrial zoning districts. In cases where homes do not front onto a neighborhood collector street, a paved multiuse path (8’ minimum) may be used in lieu of the sidewalk. Sidewalks within a neighborhood shall connect to the existing and planned future pedestrian facilities along the Thoroughfare Plan street system. In addition to sidewalks, which typically extend along the front of residential districts parallel to the street, multi-use paths (8’ minimum in street right-of-way/10’ minimum outside of street right-of-way within parkland or open space) shall be provided within all neighborhoods to supplement and connect to the neighborhood sidewalk and regional path network. Connections to the path system shall be provided in multiple locations to ensure that public pathways are easily and conveniently accessible to residents within the neighborhood and by users outside the neighborhood for recreational or active transportation purposes. Stubs shall be provided on the path network to connect to future development. Engineering judgment should be used to determine the appropriate pedestrian accommodation based on vehicle and pedestrian volume, adjacent land use, available right-of-way, and future conditions.

4.4.6 **Bicycle Facilities.** Because local streets should be designed to encourage the slow movement of vehicular traffic, bicyclists typically share the road with motorists and no

special provisions are required to accommodate on-street cyclists. Multiuse paths (8' minimum in street right-of-way/10' minimum outside of street right-of-way within parkland or open space) shall be provided within all neighborhoods to supplement and connect to the local street and the path network. Connections to the path system shall be provided in multiple locations to ensure that public pathways are easily and conveniently accessible to residents within the neighborhood and by users outside the neighborhood for recreational or active transportation purposes. Stubs shall be provided on the path network to connect to future development. Engineering judgment should be used to determine the appropriate bicycle accommodation based on vehicle and pedestrian volume, vehicle speed, adjacent land use, available right-of-way, and future conditions

4.4.7 Sidewalk and Multiuse Path Crossing of a Public Street. Pedestrians and bicyclists are critical components of a vibrant and active neighborhood and are legitimate users of the transportation system. While crossing local streets is typically safe and easy to do, certain infrastructure design elements create a more pedestrian and bicycle-friendly design. Where a sidewalk crosses a public street, the crossing of the stop-controlled side street shall be in a manner that maintains the alignment of the curb ramp and crosswalk with the approaching sidewalk or path that runs parallel to the main street, keeping the crosswalk in front of stopped vehicles on the side street and providing better visibility of pedestrians for vehicles turning from the main street to the side street at the intersection. Attempts should be made to keep the ramp crossing of the main street in line with the approaching sidewalk that runs parallel to the side street. However, narrow tree lawn widths may make this challenging. Therefore, the ramp crossing of the main street may be pulled around the radius of the curve and be offset slightly from the approaching sidewalk. In situations where a multiuse path connector intersects a local street, a curb ramp shall be provided to allow bicyclists riding on the street to access the off-street multiuse path. Crosswalks typically are not marked at local street intersections. Exceptions to this are in school zones or at high volume multiuse path crossings.

4.4.8 On-Street Parking. Provisions for on-street parking on local streets are necessary to serve adjacent property owners and help to reduce vehicle speeds. On-street parking is typically provided along both sides of neighborhood streets. However, providing on-street parking where there is little to no demand for it results in wide streets with higher vehicle speeds. While it is appropriate to locate neighborhood-serving non-residential uses (schools, community centers, public or private recreational facilities or neighborhood retail) along local streets, care should be taken to accommodate additional parking needs in the area without adversely impacting the neighborhood or making access by emergency services difficult. Housing density, housing frontage, driveway density, and the presence of non-residential uses nearby all impact the use of on-street parking. Therefore, on-street parking and street widths need to be evaluated and specifically planned during the early stages of any new development or redevelopment proposal. In some cases, street width may need to vary by block to accommodate varying levels of on-street parking, vehicle access, and appropriate two-way access for vehicles at intersections.

4.4.9 Culs-de-sac and Dead-end Streets. Culs-de-sac and dead end streets create an environment that is circuitous and unconnected, which is in opposition the principals of the Hilliard Comprehensive Plan. These types of streets are also difficult to maintain and to provide access for service vehicles. Therefore, the use of these types of streets is prohibited for new development without detailed justification by the developer in writing and approval by the City Engineer. Special approval of culs-de-sac and dead-end streets will be evaluated by the City Engineer on a case-by-case basis. In order to receive approval for these types of streets for new development, the developer shall ensure that

no eyebrows or common access drives to residential properties will be provided and the length of such streets shall be limited to 500 feet. The developer should provide one or more pedestrian/bicycle connections at the end of a cul-de-sac/dead-end street to the street or land behind the isolated street to facilitate a more direct non-vehicular connection. Separate easements shall be provided for these non-vehicular connections and the easement area shall be clearly defined to adjacent home owners through the use of fencing, landscape buffers, or other means to avoid private property encroachment upon the public pedestrian/bicycle connection. In a case where a dead-end street is provided only temporarily with the intent to extend in the future as development occurs, the intent to extend the dead-end street shall be clearly stated in the plat and through the use of signage erected at the terminus of the dead-end street.

4.4.10 Loop Streets. Similar to culs-de-sac and dead end streets, loop streets create an environment that is circuitous and unconnected, which is in opposition the principals of the Hilliard Comprehensive Plan. Loops streets frequently also result in the creation of two intersections of the same two streets. This is problematic from a mapping/GIS standpoint upon which many of today's computer and mobile applications are based. Therefore, the use of loop streets is highly discouraged. Approval of loop streets is required by the City Engineer and will be evaluated on a case-by-case basis. In order to receive approval for these types of streets for new development, the developer shall provide detailed preliminary design information on the proposed street design, including length of short and long legs of the loop street, curve radii, and lot layout to enable the City Engineer to adequately evaluate a proposed loop street design. The developer may be required to provide one or more pedestrian/bicycle connections within the length of the loop street to the street or land behind the loop street to facilitate a more direct non-vehicular connection. Separate easements shall be provided for these non-vehicular connections and the easement area shall be clearly defined to adjacent home owners through the use of fencing, landscape buffers, or other means to avoid private property encroachment upon the public pedestrian/bicycle connection.

4.4.11 Buffer Zone. A buffer zone is the area between the back of the curb (or vehicular travel lane if uncurbed) and the sidewalk or path. On the local street system, the buffer zone (or tree lawn) will predominantly consist of a grass lawn, trees, public signs, street lights, and underground utilities. In locations that include neighborhood-serving non-residential (schools, community centers, public or private recreational facilities or neighborhood retail), the buffer zone may also include other items, such as street furniture. This area provides the space for curb ramps, which pedestrians can use to transition from the sidewalk to the street. Buffer zones vary in width depending on the type and size of contents within the buffer zone. In order to provide curb ramps without altering the typical elevation of the adjacent sidewalk or multi-use path, the minimum width of the buffer zone is eight (8) feet. A wider tree lawn may be appropriate along the local street network to accommodate larger street trees with overhanging canopies that can add value to the neighborhood over time.

4.4.12 Street Trees. The benefits of street trees in an urban and suburban environment are numerous and well documented. Not only do street trees provide beauty, shade, and environmental benefits, but a well-designed street tree planting arrangement also reduces vehicle speeds, creates a safer walking environment, provides for a vertical buffer along a street, and adds value to the homes and businesses along the street. In order to achieve these benefits, street trees must be selected and placed in a manner that is appropriate for the available space. Care should be taken to ensure that street trees and other landscaping features do not block sight distance at intersections and driveways, do not block visibility of traffic control devices, and do not inhibit the illumination of the street or walks. It is

also important to consider the available horizontal space within the buffer zone and the presence of above ground or underground utilities that may be impacted by the tree or its roots as it grows. See Chapter 12 for additional information on street trees.

4.4.13 Access Management. Access is not managed on local streets except that consideration should be made to avoid placing a residential, commercial or industrial driveway within 150 feet of the intersection of the local street with the Thoroughfare Plan street. Placing driveways within this area encourages on-street parking close to the intersection, which may impede emergency access during peak periods. A better use of the first 150 feet of the local street may be landscaping or other entry features that add value to the surrounding area.

4.4.14 Design Guidance. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, commonly referred to as the "Green Book," shall guide the design of all roadways within the City of Hilliard. In all cases, engineering judgment shall be used to determine an appropriate design speed, design vehicle, and other key design parameters to create a roadside environment that balances all users. In many cases the Ohio Department of Transportation provides appropriate design guidance. However, care should be taken to ensure that the particular guidance is appropriate for streets within a municipal corporation with slower speeds and higher emphasis on mobility and safety of more vulnerable road users.

4.4.14.A Horizontal, Vertical, and Geometric Design Guidance. The most current version of the Ohio Department of Transportation (ODOT) *Location and Design Manual* shall guide and govern the site distance, horizontal alignment, vertical alignment, and geometric design of all residential streets.

4.4.14.B Roundabout Design. Modern roundabouts are typically not used at intersections of two local streets. However, mini-roundabouts or traffic calming circles may be used to control vehicle speeds and improve aesthetics within neighborhoods.

4.4.14.C Pedestrian Facility Design. The design of pedestrian facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG).

4.4.14.D Bicycle Facility Design. The design of bicycle facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG), the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, and the National Association of City Transportation Officials (NATCO) *Urban Bikeway Design Guide*.

4.4.14.E Traffic Control Design. The location and design of all traffic control devices for all streets, highways, bikeways, and private roads open to public travel are governed by the most current version of the Ohio Department of Transportation (ODOT) *Ohio Manual of Uniform Traffic Control Devices* (OMUTCD) and supplemental City of Hilliard specifications.

4.4.14.F Street Lighting Design. For information on street lighting, see Chapter 10

4.5 Conservation District

4.5.1 Applicability. There is a need to ensure that future development protects habitat and natural features within the Big Darby area. The City of Hilliard participated in and acknowledges the recommendations of the Big Darby Accord Watershed Master Plan

(BDAWMP). About 2,800 acres of the Comprehensive Plan's study area fall within the limits of the Watershed Master Plan and generally land west of Alton & Darby Creek Road. The master plan recommends development preserve sensitive environmental features in the area, including several stands of trees, numerous wetlands, and sensitive streams and agricultural ditches. The Comprehensive Plan recommends the use of conservation development principles when this area is developed, requiring the preservation of at least fifty % of new subdivisions as preserved open space.

4.5.2 Planning and Design Goals. Goals for planning and designing streets in the Conservation District include movement of motorized and non-motorized traffic in a harmonious manner, minimizing direct access to individual properties, and balancing the sometimes competing needs of large motorized users (trucks, buses, and emergency vehicles), small motorized users (cars and motorcycles), and non-motorized users (pedestrians and bicyclists). Sidewalks are only permitted in the Heritage Preserve area. Open space is required when developing new areas within the district. The location of open space on any development site, such as a conservation development that sets aside 50% of the site, should be dictated by the location of environmentally-sensitive features within topography and features of the land.

4.5.3 Roadway Characteristics. See the "Roadway Characteristics" exhibits in the appendix for more information on roadway characteristics for streets in the conservation district.

4.5.4 Speed. The speed limit on streets within the district varies depending on the functional classification of the street. Typically Thoroughfare Plan street speed limits within the Conservation District are 35 - 45 mph; local streets within the Conservation District are posted with speed limits of 25-35 mph. Roadways shall be designed in a manner to achieve 85th percentile operating speeds consistent with the speed limit. Horizontal traffic calming elements may be incorporated into new Local Street designs within the subdivisions to encourage slower vehicle speeds but not without first establishing a well-designed development layout with the roadway characteristics designated in Section 4.4.3. Examples of horizontal traffic calming measures include curb extensions at intersections and neighborhood traffic calming circles. Stop signs shall not be used for speed control.

4.5.5 Pedestrian Facilities. Sidewalks are permitted in the Conservation District, and the minimum width is 5'. Consideration should be given to using a multiuse path (8' minimum/10' recommended) in residential corridors only if homes do not front the street. Pathway lighting may be considered in high pedestrian areas or in areas where street lighting is not provided and pedestrian facilities are present. Engineering judgment should be used to determine the appropriate pedestrian accommodation based on vehicle and pedestrian volume, adjacent land use, proximity to the Heritage Rail Trail or other regional trails, available right-of-way, and future conditions.

4.5.6 Bicycle Facilities. The City supports efforts to develop regional and local trail systems that link parks and open spaces. Development of a trail within dedicated easements should be pursued in coordination with developers, land owners and metro parks. The proposal and layout of any new bicycle facilities should make an effort to connect with the Heritage Rail Trail and the future regional trail that will connect from Prairie Oaks Metropark and Hilliard Municipal Park. The design of new streets or the rehabilitation of existing streets that are on the Thoroughfare Plan should consider using bike lanes or paved shoulders (6' minimum width).

4.5.7 Sidewalk and Multi-use Path Crossing of a Public Street. Pedestrians and bicyclists are legitimate users of the transportation system, and they should, therefore, be able to use this system safely and without unreasonable delay. Pedestrians and bicyclists have a right to cross roads safely, and planners and engineers have a professional responsibility

to plan, design, and install safe and convenient crossing facilities. Where a sidewalk or multiuse path crosses a public street, the crossing of the stop or signal-controlled side street shall be in a manner that maintains the alignment of the ramp and marked or unmarked crosswalk with the approaching sidewalk or path that runs parallel to the main street, keeping the crosswalk in front of stopped vehicles on the side street and providing better visibility of pedestrians for vehicles turning from the main street to the side street at the intersection. The crossing of the main street shall be clearly defined and marked at a traffic signal or a roundabout. The crossing of the main street at an uncontrolled location, such as at an unsignalized intersection or midblock crossing, shall be evaluated on a case-by-case basis taking vehicular volume, speed, number of lanes, and visibility into consideration. Engineering judgment shall be used in establishing mid-block crossings, which are not legal crossings absent of a marked crosswalk.

4.5.8 On-Street Parking. On-street parking is not permitted on thoroughfare streets in the Conservation District. Parking is permitted on local streets and auxiliary parking areas may be permitted in subdivisions upon approval by the City Engineer. The City, however, will not be required to maintain these parking areas.

4.5.9 Buffer Zone. The buffer zone on streets in the Conservation District varies. The buffer zone is the area between the vehicular travel lane or bike lane and the off-street pedestrian/bicycle facility, if applicable. A buffer zone may be referred to as a "tree lawn" and includes space for public signs, street lights, street furniture, transit stops, utilities, trees, and other landscaping elements. Buffer zones not only provide space for necessary roadside elements, but they also provide a barrier between pedestrians and vehicular traffic. This area provides the space for curb ramps, which pedestrians can use to transition from the sidewalk to the street. Buffer zones vary in width depending on the type and size of contents within the buffer zone. In order to provide curb ramps without altering the typical elevation of the adjacent sidewalk or multiuse path, the minimum width of the buffer zone is eight (8) feet. A wider tree lawn may be appropriate in a high volume pedestrian environment, a higher speed vehicular environment, or in locations where larger street trees will be used.

4.5.10 Street Trees. The benefits of street trees in an urban and suburban environment are numerous and well documented. Not only do street trees provide beauty, shade, and environmental benefits, but a well-designed street tree planting arrangement also reduces vehicle speeds, creates a safer walking environment, provides for a vertical buffer along a street, and adds value to the homes and businesses along the street. In order to achieve these benefits, street trees must be selected and placed in a manner that is appropriate for the available space. Care should be taken to ensure that street trees and other landscaping features do not block sight distance at intersections and driveways, do not block visibility of traffic control devices, and do not inhibit the illumination of the street or walks. It is also important to consider the available horizontal space within the buffer zone and the presence of above ground or underground utilities that may be impacted by the tree or its roots as it grows. See Chapter 12 for additional information on street trees.

4.5.11 Access Management. Access management is critical on streets in the Conservation District, particularly higher level major and minor arterials, in order to preserve the capacity of the roadway and improve safety. The City of Hilliard Access Management Plan, included as a technical appendix in the Thoroughfare Plan, shall govern the location and design of driveways. The level of access management is based on the access category of the street and the volume of traffic anticipated on the driveway. Special attention shall be taken to ensure that new driveways are placed outside the functional area of intersections.

4.5.12 Design Guidance. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, commonly referred to as the "Green Book," shall guide the design of all roadways within the City of Hilliard. In all cases, engineering judgment shall be used to determine an appropriate design speed, design vehicle, and other key design parameters to create a roadside environment that balances all users. In many cases the Ohio Department of Transportation provides appropriate design guidance. However, care should be taken to ensure that the particular guidance is appropriate for streets within a municipal corporation with slower speeds and higher emphasis on mobility and safety of more vulnerable road users.

4.5.12.A Horizontal, Vertical, and Geometric Design Guidance. The most current version of the Ohio Department of Transportation (ODOT) *Location and Design Manual* shall guide and govern the site distance, horizontal alignment, vertical alignment, and geometric design of all Conservation District streets.

4.5.12.B Roundabout Design. The design of modern roundabouts shall be governed by the National Cooperative Highway Research Program (NCHRP) Report 672 *Roundabouts: An Informational Guide, Second Edition* or subsequent later editions. Roundabouts shall be evaluated for all new intersection improvements in the City of Hilliard unless the intersection is within a closed loop signal system.

4.5.12.C Pedestrian Facility Design. The design of pedestrian facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG). All public street intersections are legal pedestrian crossings. Safe and convenient pedestrian crossing of the public streets shall be considered at all times. Engineering judgment shall be used in the design of pedestrian crossings with particular attention made at uncontrolled locations, which may benefit from the installation of raised medians for pedestrian refuge or other high visibility treatments or enhancements to improve pedestrian safety. Volume and speed of vehicular traffic, volume of pedestrian traffic, and location of high pedestrian generating land uses shall be evaluated in determining the best crossing treatment at a given location.

4.5.12.D Bicycle Facility Design. The design of bicycle facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG), the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, and the National Association of City Transportation Officials (NATCO) *Urban Bikeway Design Guide*.

4.5.12.E Traffic Control Design. The location and design of all traffic control devices for all streets, highways, bikeways, and private roads open to public travel are governed by the most current version of the Ohio Department of Transportation (ODOT) *Ohio Manual of Uniform Traffic Control Devices* (OMUTCD) and supplemental City of Hilliard specifications.

4.5.12.F Street Lighting Design. For information on street lighting, see Chapter 10.

4.6 Old Hilliard District

4.6.1 Applicability. Roadways that are within the Old Hilliard District include all or portions of:

Thoroughfare Plan streets: Main Street, Norwich Street, and Center Street

Local streets: North Street, Franklin Street, Madison Street, Wayne Street, and Columbia Street

Roadways within the Old Hilliard District place a high priority on pedestrian accessibility and encourage the use of the public right-of-way as a public gathering space.

4.6.2 Planning and Design Goals. Goals for planning and designing streets within the Old Hilliard District include movement of pedestrians in a safe and convenient manner. This includes the use of wider sidewalks, smaller turning radii at corners, enhanced pedestrian crossings, on-street parallel or back-in angle parking, and buffered areas with street furniture and landscaping. Design elements that encourage high vehicle speeds, turn lanes, or wider pavements are strongly discouraged in the Old Hilliard District. Similarly, land uses that require such design elements should be avoided.

4.6.3 Roadway Characteristics. All streets within the Old Hilliard District include a maximum of one through lane in each direction. Design of wide driveways or additional turn lanes to accommodate uses that are vehicle intense are discouraged. A grid-style street network with short block lengths shall be maintained and extended wherever feasible. Curb extensions at intersections are desirable design elements to shorten pedestrian crossings and slow vehicle speeds. Access to serve commercial uses in the Old Hilliard District should be to the rear via alleys. Access to serve residential uses in the Old Hilliard District may be to the front, but garages should be set back from the front of the house to deemphasize the vehicle accessibility. Curb and gutter is not permitted for streets within this District. See the "Roadway Characteristics" exhibits in the appendix for more information on roadway characteristics for streets in Old Hilliard.

4.6.4 Speed. The speed limit on streets within the Old Hilliard District is 25 mph or less. Roadways shall be designed in a manner to achieve 85th percentile operating speeds consistent with the speed limit. Horizontal traffic calming elements, such as curb extensions, may be incorporated into new Old Hilliard street designs to encourage slower vehicle speeds. Stop signs shall not be used for speed control.

4.6.5 Pedestrian Facilities. Sidewalks (5' minimum width) are required on both sides of all Old Hilliard District streets. Commercial corridors with buildings at or near the right-of-way line should have sidewalks greater than 5' to accommodate higher pedestrian traffic. Consideration may be given to using a multiuse path (8' minimum/10' recommended) in residential corridors or commercial corridors with buildings set further back from the right-of-way line. Engineering judgment should be used to determine the appropriate pedestrian accommodation based on vehicle and pedestrian volume, adjacent land use, proximity to the Heritage Rail Trail, available right-of-way, and future conditions.

4.6.6 Bicycle Facilities. The Heritage Rail Trail bisects the Old Hilliard District and provides an important recreational and transportation resource to the community. The grid network of streets in Old Hilliard presents a unique opportunity to provide multiple connections to the Heritage Rail Trial through the use of low volume local streets within the District. Since streets within the Old Hilliard District should be designed to encourage the slow movement of vehicular traffic, experienced bicyclists can share the road with motorists, even on the higher volume streets like Main Street and Norwich Street. Less experienced cyclists would be better served by using lower volume alternate parallel routes such as Columbia Street and Wayne Street. To allow cyclists to bypass the busy Main Street corridor, Madison Street, Columbia Street, North Street, and Wayne Street should be designated as bike boulevards to give priority to slower moving bicyclists and provide better access to the Heritage Rail Trail. Engineering judgment should be used to determine the appropriate bicycle accommodation based on vehicle and pedestrian volume, vehicle speed, adjacent land use, connectivity to the Heritage Rail Trail, available right-of-way, and future conditions.

4.6.7 Sidewalk and Multiuse Path Crossing of a Public Street. Pedestrians and bicyclists are legitimate users of the transportation system, and they should, therefore, be able to use this system safely and without unreasonable delay. Pedestrians and bicyclists have a right to cross roads safely, and planners and engineers have a professional responsibility to plan, design, and install safe and convenient crossing facilities. Pedestrians and bicyclists should be included as design users for all City streets. Where a sidewalk or multiuse path crosses a public street, the crossing of the stop or signal-controlled side street shall be in a manner that maintains the alignment of the ramp and marked or unmarked crosswalk with the approaching sidewalk or path that runs parallel to the main street, keeping the crosswalk in front of stopped vehicles on the side street and providing better visibility of pedestrians for vehicles turning from the main street to the side street at the intersection. The crossing of the main street shall be clearly defined and marked at a traffic signal. The crossing of the main street at an uncontrolled location, such as at an unsignalized intersection or midblock crossing, shall be evaluated on a case-by-case basis taking vehicular volume, speed, number of lanes, and visibility into consideration. Engineering judgment shall be used in establishing mid-block crossings, which are not legal crossings absent of a marked crosswalk.

4.6.8 On-Street Parking. On-street parking is critical to the vitality of the Old Hilliard District. Because of narrow rights-of-way and the need to provide pedestrian facilities along all streets within the Old Hilliard District, parallel parking is the most logical choice because it requires the least amount of horizontal space within the public right-of-way. In locations where a wider right-of-way is available, back-in angle parking should be considered to maximize the number of public parking spaces. Perpendicular parking and traditional front-entry angle parking should be avoided because of the safety concerns these types of parking arrangements present for through motorists and bicyclists sharing the street. On-street parking should be designed in conjunction with curb extensions to protect parked cars, calm through traffic, and provide a shorter pedestrian crossing area at intersections.

4.6.9 Buffer Zone. A buffer zone is the area between the back of the curb and the off-street pedestrian/bicycle facility. A buffer zone may be referred to as a “tree lawn” and includes space for public signs, street lights, street furniture, transit stops, utilities, trees, and other landscaping elements. Buffer zones not only provide space for necessary roadside elements, but they also provide a barrier between pedestrians and vehicular traffic. This area provides the space for curb ramps, which pedestrians can use to transition from the sidewalk to the street. Buffer zones vary in width depending on the type and size of contents within the buffer zone. In order to provide curb ramps without altering the typical elevation of the adjacent sidewalk or multi-use path, the minimum width of the buffer zone is eight (8) feet. The buffer zone is a critical design element in the Old Hilliard District; therefore, attempts should be made to maximize this space.

4.6.10 Street Trees. The benefits of street trees in an urban and suburban environment are numerous and well documented. Not only do street trees provide beauty, shade, and environmental benefits, but a well-designed street tree planting arrangement also reduces vehicle speeds, creates a safer walking environment, provides for a vertical buffer along a street, and adds value to the homes and businesses along the street. In order to achieve these benefits, street trees must be selected and placed in a manner that is appropriate for the available space. Care should be taken to ensure that street trees and other landscaping features do not block sight distance at intersections and driveways, do not block visibility of traffic control devices, and do not inhibit the illumination of the street or walks. It is also important to consider the available horizontal space within the buffer zone and the

presence of above ground or underground utilities that may be impacted by the tree or its roots as it grows. See Chapter 12 for additional information on street trees.

4.6.11 Access Management. Access management is critical in the Old Hilliard District because fewer access points results in fewer conflict points for pedestrians and bicyclists. However, this must be balanced with the desire to provide multiple small access points rather than fewer high volume access points. The grid system of streets and alleys in the Old Hilliard District presents a unique opportunity to balance these needs. Access to serve commercial uses in the Old Hilliard District should be to the rear via alleys. When no alley is available, access should be provided via the secondary side streets rather than direct access to Main Street. Access to serve residential uses in the Old Hilliard District may be to the front, but garages should be set back from the front of the house to deemphasize the vehicle accessibility. Restriction of access is critical along commercial corridors. A more relaxed approach to access management may be taken along residential corridors. However, if an existing residential corridor is likely to be converted to commercial or multi-family through redevelopment, access needs to be carefully planned. The City of Hilliard Access Management Plan, included as a technical appendix in the Thoroughfare Plan, shall govern the location and design of driveways. The level of access management is based on the access category of the street and the volume of traffic anticipated on the driveway. Special attention shall be taken to ensure that new driveways are placed outside the functional area of intersections.

4.6.12 Design Guidance. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, commonly referred to as the "Green Book," shall guide the design of all roadways within the City of Hilliard. In all cases, engineering judgment shall be used to determine an appropriate design speed, design vehicle, and other key design parameters to create a roadside environment that balances all users. In many cases the Ohio Department of Transportation provides appropriate design guidance. However, care should be taken to ensure that the particular guidance is appropriate for streets within a municipal corporation with slower speeds and higher emphasis on mobility and safety of more vulnerable road users.

4.6.12.A Horizontal, Vertical, and Geometric Design Guidance. The most current version of the Ohio Department of Transportation (ODOT) *Location and Design Manual* shall guide and govern the site distance, horizontal alignment, vertical alignment, and geometric design of all streets within the Old Hilliard District.

4.6.12.B Roundabout Design. The design of modern roundabouts shall be governed by the National Cooperative Highway Research Program (NCHRP) Report 672 *Roundabouts: An Informational Guide, Second Edition* or subsequent later editions. Roundabouts shall be evaluated for all new intersection improvements in the City of Hilliard unless the intersection is within a closed loop signal system.

4.6.12.C Pedestrian Facility Design. The design of pedestrian facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG). All public street intersections are legal pedestrian crossings. Safe and convenient pedestrian crossing of the public streets shall be considered at all times. Engineering judgment shall be used in the design of pedestrian crossings with particular attention made at uncontrolled locations, which may benefit from the installation of raised medians for pedestrian refuge or other high visibility treatments or enhancements to improve pedestrian safety. Volume and speed of vehicular

traffic, volume of pedestrian traffic, and location of high pedestrian generating land uses shall be evaluated in determining the best crossing treatment at a given location.

4.6.12.D Bicycle Facility Design. The design of bicycle facilities is governed by the most current version of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG), the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, and the National Association of City Transportation Officials (NATCO) *Urban Bikeway Design Guide*.

4.6.12.E Traffic Control Design. The location and design of all traffic control devices for all streets, highways, bikeways, and private roads open to public travel are governed by the most current version of the Ohio Department of Transportation (ODOT) *Ohio Manual of Uniform Traffic Control Devices* (OMUTCD) and supplemental City of Hilliard specifications.

4.6.12.F Street Lighting Design. See Chapter 10 for information on lighting in the Old Hilliard District.

4.7 Pavement Design Information

4.7.1 General

4.7.1.A The minimum requirements that follow are based on adequate subgrade, subgrade drainage and traffic loads (specifically commercial vehicle percentage). Soil borings must be conducted for each project, and a geotechnical engineer must supply their recommendations on the suitability of the proposed pavement section. Each site must be examined individually and additional pavement thickness and/or base requirements may be necessary.

4.7.1.B The soil borings must provide a subgrade structural capacity number. The maximum allowable subgrade structural number by the City is 3. It may be less but in no instances will a number greater than 3 be allowed as part of the overall pavement structural number calculation.

4.7.1.C All pavement surfaces must be supported upon a prepared subgrade that has been compacted to at least 95% of maximum unit weight in accordance with ODOT standards.

4.7.1.D Should it be found that the excavation, removal and replacement of unstable subgrade material is impractical due to excessive depths, alternate pavement structure designs must be prepared by a geotechnical engineer and submitted to and approved by the City Engineer prior to pavement installation.

4.7.1.E Roller compacted concrete (RCC) may be substituted for bituminous base course, ODOT 301, for any of the Thoroughfare sections. The design shall be per the City of Columbus Supplemental Specification 1523. Noted exceptions include:

- Standard typical section is a fully flexible (asphalt) pavement. A roller compacted concrete base can be used in lieu of an asphalt base with special approval by the City Engineer.

- After placement of the intermediate and surface course asphalt pavement, the asphalt shall also be sawcut at the same locations as the underlying RCC pavement. The joints in the asphalt surface course shall be scored and sealed to control cracking.
- A min. compacted aggregate base of 4" shall be provided beneath the RCC.
- The RCC pavement section meets or exceeds the structural number of the flexible pavement section as determined by a geotechnical engineer. Pavement design must be submitted to the City Engineer for approval.
- The curb shall be marked at the location of each transverse contraction joint as a guide for sawcutting the asphalt after it is placed.

4.7.1.F Underdrain (ODOT Item 605) is required for all public roads.

4.7.2 Thoroughfare Plan Streets

The following pavement design applies to all portions of the roadway, including paved shoulders and on-street bicycle facilities.

4.7.2.A Arterials

1) Subgrade Requirements:
   All subgrade, prior to placement of aggregate base course, must be compacted via proof-roll. When unstable subgrade materials, i.e., peat, muck, marl, wet clays, etc., are encountered, excavation and removal of such unstable materials and replacement to plan subgrade with approved materials compacted in place will be required. Fill materials must be approved by the City Engineer.
   Should it be found that the excavation, removal and replacement of unstable subgrade material is impractical due to excessive depths, alternate pavement structure designs must be submitted to and approved by the City Engineer prior to pavement installation.

2) Aggregate Base Requirements:
   A minimum of a 6" compacted thickness of ODOT 304 aggregate base course material will be placed for all roadways. Base shall be compacted to at least 95% of maximum dry density as determined by AASHTO T-99.

3) Asphalt Requirements (minimum)
   a) 9" bituminous base course, ODOT 301, PG64-22.
   b) 1.5" bituminous intermediate course, ODOT 441, Type 2 PG64-22
   c) 1.5" bituminous surface course, ODOT 441, Type 1 PG64-22

   The suitability of these minimum pavement cross section designs to meet the specific requirements of the project should be verified by an engineer.

4.7.2.B Network Collectors

1) Subgrade Requirements:
   All subgrade, prior to placement of aggregate base course, must be compacted via proof-roll. When unstable subgrade materials, i.e., peat,

muck, marl, wet clays, etc., are encountered, excavation and removal of such unstable materials and replacement to plan subgrade with approved materials compacted in place will be required. Fill materials must be approved by the City Engineer.
Should it be found that the excavation, removal and replacement of unstable subgrade material is impractical due to excessive depths, alternate pavement structure designs must be submitted to and approved by the City Engineer prior to pavement installation.

2) Aggregate Base Requirements:
A minimum of a 6" compacted thickness of ODOT 304 aggregate base course material will be placed for all roadways. Base shall be compacted to at least 95% of maximum dry density as determined by AASHTO T-99.

3) Asphalt Requirements (minimum):
   a) 6" bituminous base course, ODOT 301, PG64-22
   b) 1.5" bituminous intermediate course, ODOT 441, Type 2 PG64-22
   c) 1.5" bituminous surface course, ODOT 441, Type 1, PG64-22

The suitability of these minimum pavement cross section designs to meet the specific requirements of the project should be verified by an engineer.

4.7.3 Residential Streets

Roadway Width	Aggregate Base Course ODOT (304)	Bit Base Course ODOT (301)	Roller Compacted Concrete (RCC) COLS SS (1523)	Asphalt Concrete Intermediate Course, Type 2 PG64-22 ODOT (441)	Asphalt Concrete Surface Course, Type 1 PG64-22 ODOT (441)
26 '	8"			2.5"	1.5"
32' or 36' with Asphalt Base	6"	4"		1.5"	1.5"
32' or 36' with RCC Base	4"		6"	1.5"	1.5"

4.7.4 Shared Use Paths

The following pavement design is applicable for separated, off-street pedestrian/bicycle facilities.

a) 6" aggregate base course, ODOT 304.
b) 2.5" bituminous intermediate course, ODOT 441, Type 2, PG64-22
c) 1.5" bituminous surface course, ODOT 441, Type 1, PG64-22

Chapter 5: Sanitary Sewers

5.1 Design Requirements

5.1.1 The design requirements and supplemental specifications of the City of Hilliard, along with the current edition of the City of Columbus Construction and Materials Specifications (CMS), the City of Columbus Division of Sewerage and Drainage Standard Construction Drawings, and the City of Columbus Sanitary Sewer Design Manual shall govern the design of all sanitary sewer lines in the City of Hilliard.

5.1.2 An Ohio EPA Permit-To-Install (PTI) is needed when an individual wishes to construct any publicly owned and maintained wastewater collection, storage or treatment system or wishes to modify any existing wastewater collection, storage or treatment system.

5.1.3 When an individual wishes to construct, modify or replace an existing sanitary line that is on private property, a permit through the City of Hilliard must be obtained and a fee must be paid. The permit form and fee schedule can be obtained from the City of Hilliard Building Department. This pertains to any work outside of the right-of-way or easement.

5.2 Standard Drawings

The standard drawings of the City of Hilliard along with the City of Columbus current editions shall be referenced for all sanitary sewer line design.

Chapter 6: Water Lines

6.1 Design Requirements

The design requirements and supplemental specifications of the City of Hilliard, along with the current edition of the City of Columbus Construction and Material Specifications (CMS) and the Division of Water Standard Detail Drawings – Distribution System shall govern the design of all water lines within the City of Hilliard corporation limits.

6.1.1 When installing a new water line, service lines are required to be installed and tested from the main line to the curb stop. The owner/developer is required to keep as-built information and fill out a "Water Service Report" for each water service constructed. The form for the "Water Service Report" can be found in the appendix of this Manual. The report shall be submitted to the City of Hilliard as part of the water line chlorination request submittal.

6.1.2 An Ohio EPA Permit-To-Install (PTI) is needed when an individual wishes to construct any publicly owned and maintained water line.

6.1.3 When an individual wishes to construct, modify or replace a water line that is on private property, a permit through the City of Hilliard must be obtained and a fee must be paid. The permit form and fee schedule can be obtained from the City of Hilliard Building Department. This pertains to any work outside of the right-of-way or easement.

6.2 Noted Exceptions

Exceptions to the CMS include:

6.2.1 Section 809.02, Description of Fire Hydrants

The following City of Hilliard fire hydrant specifications shall supersede Section 809.02:

6.2.1.1 Fire hydrants shall be post type, made of cast iron, and shall conform in all respects to the "American Water Works Association Standard for Dry-Barrel Fire Hydrants," ANSI/AWWA C502-85, except where modified herein.

6.2.1.2 Main valve shall be compression type opening against the pressure and closing with the pressure. Main valve seat shall be made of bronze and shall be designed to allow easy replacement in the field. The design shall eliminate the contact of dissimilar metals in areas of the hydrant that are subject to the continuous presence of moisture.

6.2.1.3 All internal working parts shall be removable from the top of the hydrant, with simple tools, and without disturbing the ground line joint or the upper section of the hydrant barrel.

6.2.1.4 Breakable traffic features shall be provided, and shall include a breakable safety flange on the ground line joint, and a breakable coupling on the main valve stem at the ground line joint. The design shall assure that on heavy impact, the upper

and lower sections of the hydrant will break apart cleanly without damage to any other hydrant parts. The ground line joint shall be designed to allow the nozzle section of the hydrant to be rotated 360 degrees.

6.2.1.5 Nozzles shall be bronze and replaceable, designed for easy removal from the hydrant barrel, in the field, with simple tools.

6.2.1.6 Main valve opening shall be 4-1/2 inches in diameter for use in residential areas and 5-1/4 inches in diameter for use in commercial areas & multifamily developments as defined by the Ohio Building Code.

6.2.1.7 Hydrants shall have two (2) hose nozzles, 2-1/2 inches inside diameter with National Standard threads.

6.2.1.8 Hydrants shall have one (1) pumper nozzle, 4-1/2 inches inside diameter with National Standard threads.

6.2.1.9 Storz Connection – see standard drawing FDC-1. All fire hydrants installed in the City of Hilliard shall be fitted with a 5" Storz connection with National Standard thread in accordance with Norwich Township Fire Department standards.

6.2.1.10 Main valve shall open counterclockwise (left).

6.2.1.11 Operating nut shall be pentagon shaped, measuring 1-1/2 inches from point to opposite flat.

6.2.1.12 Bury shall be five (5) feet unless otherwise specified.

6.2.1.13 Draining devices shall be eliminated or the drain holes plugged.

6.2.1.14 The shoe shall have a six (6) inch-diameter inlet and a mechanical joint connection with accessories.

6.2.1.15 Fire hydrants approved for use in the City of Hilliard are the American Darling "Mark 73" or "B-84-B", the Clow "Medallion," and the Mueller "Centurion."

6.2.1.16 The Contractor/Developer shall submit detailed drawings and specifications for the hydrant to the Service Director for approval prior to installation.

6.2.1.17 For publicly-owned and maintained hydrants (located in public street right-of-way or an abutting easement), the color of the barrel and caps shall be Royal Blue, Sherwin Williams #6510 or approved equal, and the color of the bonnet shall be white. 3M high intensity reflectorized tape #3875 (blue) shall be wrapped around the top of the barrel, just below the bonnet.

6.2.1.18 For privately owned and maintained hydrants (located on private property), the color of the barrel and caps shall be Real Red, Sherwin Williams #6868 or approved equal, and a white bonnet is permitted. 3M high intensity reflectorized tape #3872 (red) shall be wrapped around the top of the barrel, just below the bonnet.

6.2.1.19 Where four (4) or more fire hydrants are to be installed on the project, or any phase of the project, the Contractor, Developer, or Owner shall furnish and deliver to the City of Hilliard, at no cost to the City, one (1) complete fire hydrant. When more than ten (10) fire hydrants are installed, an additional fire hydrant shall be furnished and delivered to the City of Hilliard, at no cost to the City. Each extra fire hydrant shall be complete with accessories, including operating wrench, special wrenches and tools, lubricants, and a repair kit necessary for the operation, maintenance and repair of fire hydrants.

6.2.2 Section 809.08, Basis of Payment

The following City of Hilliard fire hydrant specification shall supersede Section 809.08:

6.2.2.1 Description shall include either "Fire Hydrant, Type "A" "or "Fire Hydrant, Type "A modified" " or "Fire Hydrant, Type "B" "or "Fire Hydrant, Type "B modified."

6.2.2.2 Description shall include "as per plan" with each type of fire hydrant, as per plan.

6.3 Standard Drawings

The standard drawings of the City of Hilliard along with the City of Columbus current editions shall be referenced for all water line design.

Chapter 7: Stormwater

7.1 INTRODUCTION

This Manual establishes design criteria required for stormwater facilities within the City of Hilliard in conjunction with City Ordinance Part Eleven, Titles Three and Seven and the Ohio Environmental Protection Agency's (OEPA) National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Program. While adherence to this Manual will not stop flooding or prevent all damage caused by flooding, it does establish a basis for design which will:

- Minimize the damage and inconvenience of flooding;
- Provide drainage systems which continue to provide benefit over the long term;
- Minimize the expense of maintaining the drainage facilities within the City;
- Reduce non-point-source pollution;
- Minimize new impacts on engineered and natural drainage systems;
- Prevent or reduce impacts to stream and river ecosystems.

An Ohio EPA Permit-To-Install (PTI) is needed when a person wishes to construct any wastewater collection, storage or treatment system or wishes to modify any existing wastewater collection, storage or treatment system.

7.1.1 Administration

The ***City Engineer or their designee*** is authorized to administer, implement and enforce the provisions of this Manual. The City Engineer shall serve as the principal executive officer for stormwater management for the purposes of fulfilling the requirements of the OEPA's NPDES Phase II Stormwater Program. Compliance with this Manual will be determined by the City Engineer and his/her office. The City Planning Commission shall not recommend for approval the final plat of any development or subdivision over which it has jurisdiction without documentation from the City Engineer, that such the development or subdivision has been designed to be in compliance with the design requirements herein.

7.1.2 Drainage Policy

7.1.2.1 This drainage policy, control guidelines and criteria do not provide solutions to all drainage problems, nor is the engineer restricted to these designs or procedures exclusively. Although the policies as stated will hold true for most development work, the City realizes that there may be individual projects involving special or unusual drainage design problems that should be reviewed prior to completing the requisite Master Drainage Plan. Exceptions may be granted by the City Engineer to the policies and criteria in such cases when engineering study(s) justify modification.

7.1.2.2 Master Drainage Plan Requirement. For all new development, a Master Drainage Plan for the total development area shall be prepared and presented to the City Engineer for review and approval with the preliminary site development plan submitted to the Planning and Zoning Commission. The Master Drainage Plan does not constitute a detailed working design or plan from which storm sewer improvements can be constructed, nor is such detail necessary to meet the objectives of preliminary drainage review. The Master Drainage Plan shall be reviewed and approved by the City Engineer prior to initiating detailed site engineering designs. The required content of the Master Drainage Plan is as follows:

a. A topographic contour map, with the drainage area delineated, with a plan for draining the total upstream tributary watershed through the proposed development.

b. A topographic map with at least 2-foot contour interval, with general layout of the proposed inlets and storm sewers for the total development showing all existing drainage structures with size and invert elevations.

c. The capacity of the downstream open channel, culvert or storm sewer that may be used for an outlet.

d. The points downstream that may be used as a control to affirm the maximum allowable release rate of stormwater runoff for the design storm.

e. The routing path to be provided for runoff in the event the drainage facilities' capacity is exceeded. This path will become part of a grading plan, which will be submitted with detail plans. The routing path should be continuous from one development to the next.

f. A general delineation of all easements, conservation areas, Stream Corridor Protection Zone (SCPZ), reserves, etc. to be provided as part of the master stormwater plan. The width of easement to be shown on the plans.

g. Stormwater management quantitative and qualitative controls shall be located on the plan and shall become part of the routing path. Excess stormwater shall be kept out of proposed habitable structures.

7.1.2.3 Land uses and developments which increase runoff rate or volume shall control the discharge rate of runoff prior to its release to off-site land or the Municipal Separate Storm Sewer System (MS4).

a. Land uses and developments which increase runoff rate or volume shall control the discharge rate of runoff prior to its release to off-site land.

b. Surface water runoff from a development shall be drained off site to an adequate drainage outlet. The location of the outlet shall be approved by the City Engineer and may consist of a ditch, stream, storm sewer, or approved detention basin having sufficient capacity to accommodate the surface water runoff in an engineered manner.

c. It is the responsibility of the property owner to not change or alter any drainage course, ditch, flood routing path or drainage system on his/her property that will cause increased runoff, or will damage or cause flooding to adjacent, upstream or downstream property owners.

d. All stormwater drainage systems, including conveyances, within a development shall be designed to have capacity and depth, including sufficient invert elevations to permit future connections, to serve that total tributary area at the design storm frequency, and based on the rate of single family, residential runoff. The system for the upstream tributary area must be extended through the development.

e. All proposed development with a runoff rate greater than that which the downstream system has capacity for, or will be designed for, will be required to control the rate of stormwater discharge based upon the capacity of the downstream system.

f. All developments will be required to control the peak flow rate of stormwater discharge, in accordance with critical Storm method. (See Section 2.0)

g. A Stormwater Plan shall be submitted to the City for review and approval prior to the commencement of work at any proposed development site.

h. All information necessary shall be submitted to the City to determine how stormwater runoff should be controlled within the development prior to its release to downstream properties. The tributary area and the upstream watersheds should be determined using natural land divides unless man-made alterations are approved by the City Engineer as the basis for watershed delineations.

i. This Stormwater Design Manual applies to all land developments and redevelopments within the City of Hilliard and does not preclude the requirement for permits from state and federal agencies, including compliance with the most current version of the Ohio EPA's General Permit for Stormwater Discharges. The following potential exceptions and waivers to the peak flow control requirements are as listed below and in 7.1.3.3 f.

1. Exemptions:

    i. Land preparation for agriculture crops, orchards, woodlots, sod farms, and nursery operations.
    ii. A single-family residential structure not part of a larger common development or sale
    iii. A two, three, or four unit multi-family structure not part of a larger common development or scale
    iv. Managed open space associated with parks, golf courses, cemeteries, and other similar land uses including associated paved trails and roadways needed for the function of the land use.
    v. Existing public right-of-way improvements including minor road widening increase in impervious area, and bridge crossings.
    vi. Linear utility line installations
    vii. Development with less than 5,000 square feet of impervious area.
    viii. Properly permitted environmental restoration projects including wetlands, stream restoration, and other related activities.

2. Waivers

    i. It is conceivable that development situations not automatically subject to exemptions may exist such that development will have none of the harmful effects associated with increases in runoff rates and volume. Such developments are eligible for a waiver. The waiver applies only to the requirement that stormwater runoff be controlled through detention, and does not in any way imply a relaxation in the requirement for adequate on-site drainage or the ability to accept runoff from land tributary to the development.
    ii. The waiver applicant must request in writing that said requirements for stormwater runoff control be waived. The application shall include sufficient technical detail to demonstrate that the project will provide the same level of flood protection and water quality protection as those provided for in the Stormwater Design Manual. Under no circumstances shall a waiver be granted where the result will be increased flooding or that the added volume of runoff or pollutants may adversely impact the receiving stream or system.

iii. A condition of the waiver shall be that any addition, extension, or modification of a development for which a waiver has been granted shall be required to provide stormwater runoff control for the entire site if preceding limitations are exceeded by subsequent additions, extensions, or modifications.
iv. The City granting a waiver does not mitigate the need to meet the requirements of the most current version of the Ohio EPA's General Permit for Stormwater Discharges Associated with Construction Activity, both the statewide permit and the permit specific to the Big Darby Creek watershed.

7.1.3 Stream Corridor Protection

The Stream Corridor Protection Zone (SCPZ) is established through designation of a riparian setback that will be required on all stream channels (refer to definition in Glossary). The applicant shall identify and label all streams within the project site along with the appropriately defined SCPZ, relying on published data and/or site specific information collected by the Applicant. The SCPZ shall be kept in as natural a state as possible so that it can perform its inherent function of erosion protection, flood storage, and water quality protection. The SCPZ for streams within the City of Hilliard has been mapped by the City. A copy of the mapped protection zones may be obtained from the City Engineer and is also found on the City's website. The map provided by the City of Hilliard should only be used for reference purposes.

7.1.3.1 Locations Within the Big Darby Creek Watershed

For locations within the Big Darby Creek watershed, the actual designation of the SCPZ on any specific parcel shall be determined by the applicant using the 'Riparian Setback Requirements' provided in the most current version of the OEPA's General Permit for Stormwater Discharges Associated with Construction Activity within the Big Darby Creek watershed.

The SCPZ map provided by the City for areas within the Big Darby Watershed illustrates a 'Priority Stream Restoration Zone' identified within the Big Darby Accord Watershed Master Plan. The OEPA's General Permit provides a contingency for stream restoration that would redefine the SCPZ boundary, which is approximately shown on the map as "SCPZ w/Stream Restoration". The actual SCPZ boundary associated with a stream restoration project would be determined as part of the project development process.

7.1.3.2 Locations Outside of the Big Darby Creek Watershed

For locations outside of the Big Darby Creek watershed, the SCPZ shall be determined using the criteria described below.

a. The width of the SCPZ shall be based upon the following formula and also considering site specific conditions or the Federal Emergency Management Agency (FEMA) designated floodway, whichever is wider:

$$SW = 147 \times DA^{0.37}$$

Where:

SW= Setback (streamway) width measured in feet, being the total width of the protection setback at a stream channel cross-section,

DA= Drainage area in square miles

Using this formula, the SCPZ is approximately 10 channel widths (bank-to-bank).

b. Mapping:
The SCPZ setback will be centered on the channel centerline. However, the position of the boundary may be modified at the City Engineer's discretion to include known areas of environmental sensitivity in close proximity to channels banks, to include sensitive steep slopes adjacent to a channel edge or to exclude high terrain that is adjacent to a stream channel. In areas where the channel meanders, the SCPZ may not always be centered over the stream. In this case, it is better visualized as a flood path or roughly the floodway. Thus, setback areas should be fit to the channel valley. They shall be positioned so that corresponding left and right boundary elevations match and the setback area incorporates the lowest elevations in the valley.

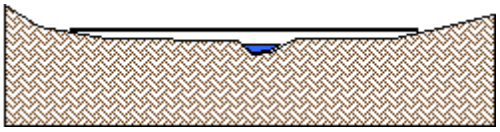


Figure 7-1. SCPZ Centered over Floodway with Matching Elevations at either Boundary.

The SCPZ shall be a combination of two overlapping areas, one based on the calculated setback (streamway) width and the other based on a minimum distance from the channel bank, equivalent to one (1) channel width as illustrated in Figure 7-1.

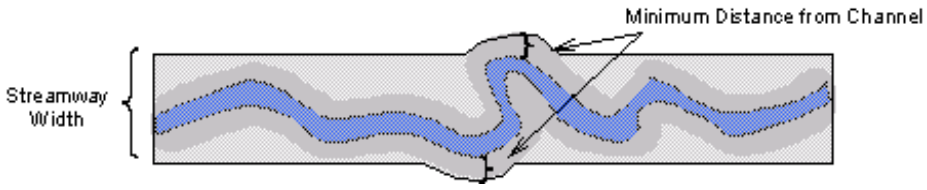
In addition, at no point shall the distance between the setback boundary and the channel be less than:

$Md = 14.7 \times DA^{0.38}$

Where:

Md= The minimum distance from the channel bank.

DA= Drainage area in square miles



This formula estimates a minimum distance of approximately one channel width.

Figure 7-2. SCPZ as a Combination of the Streamway and Minimum Distance from Channel.

c. Considering all of the criteria in paragraphs a. and b., the minimum width will be 50 feet plus the width of the channel (i.e., 25-feet on each side of the channel, measured from the channel bank). The maximum width will be 250 feet plus channel width, or the width of the floodway.

d. The SCPZ must be clearly shown on site development plans.

7.1.3.3 Construction Limitations

The following conditions shall apply to all Stream Corridor Protection Zones:

a. Except as otherwise provided in this regulation, the SCPZ shall be preserved in its natural state.

b. Prior to any earthmoving or clearing and grubbing activity on a development property, the SCPZ shall be clearly delineated on the site by the applicant or their designated representative. Such delineation shall also be identified on the Erosion and Sediment Pollution Control Plan, as indicated below, and this delineation shall be maintained throughout soil disturbing activity.

    1. An Erosion and Sediment Control Plan shall be prepared and submitted to the City for all developments which require improvements to be more than one acre of land. The Erosion and Sediment Control Plan shall conform to any and all standards defined in the Ohio Environmental Protection Agency Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System, (permit number OHC000002 which became effective April 21, 2003) and all revisions and amendments thereto. A copy of the Notice of Intent, as required to be filed with the Ohio Environmental Protection Agency, as well as a copy of the storm water pollution prevention plan, shall be provided to the City as part of the Erosion and Sediment Control Plan submittal.

c. No later than the conclusion of construction, the applicant shall permanently delineate the SCPZ in an aesthetically harmonious manner, approved by the City Engineer, such that the location of the riparian setback boundary defining the SCPZ is apparent to the casual observer,

d. Language prohibiting property owners from constructing facilities and performing activities that are prohibited within the SCPZ shall be shown on the plat or separate instrument and reflected on all deeds.

e. Land contained within the SCPZ may, at the applicant's option and if approved by the City of Hilliard's Council, be deeded in fee simple to the City of Hilliard. Alternatively, the land contained within the SCPZ shall be preserved via dedicated conservation easement, environmental covenant or reserve.

f. Any proposed encroachments within a SCPZ that are not permissible as defined in paragraph 1.3.4a., must be first granted a waiver by the City. A waiver request must be made in writing to the City with sufficient technical justification to support the request. A waiver to permit activities within the SCPZ is subject to the provision for mitigation proposed by the applicant to sufficiently offset the impacts of the SCPZ encroachments, as indicated below.
    1. For any encroachments within the SCPZ and outside of the stream channel, mitigation must meet the requirements of the most current version of the Ohio EPA's General Permit for Stormwater Discharges Associated with Construction Activity within the Big Darby Creek watershed.
    2. For any encroachments within a stream channel, in addition to the requirements of paragraph 7.1.3.3 f. 1., the applicant shall obtain all necessary permits from the U.S. Army Corps of Engineers, Ohio EPA, and other regulatory agencies, as needed, with sufficient demonstration of mitigation that shall be the responsibility of the applicant to implement and to monitor to the satisfaction of the permitting agencies.
    3. For SCPZ encroachments within the Big Darby Creek watershed, the applicant is responsible for providing the necessary documentation to and seeking the approval of the Ohio EPA under the aforementioned General Permit

7.1.3.4 Permitted, Conditional and Prohibited Uses

The permitted, condition and prohibited uses described below are derived from the OEPA's State Water Quality Management (Section 208) Plan, Appendix 9-3.

a. Permitted uses and activities. No use or activity permitted shall be construed as allowing trespass on privately held lands. The following uses are permissible within the SCPZ.

    1. Passive Uses. Uses that are passive in character shall be permitted in the SCPZ, including, but not limited to, passive recreational uses, as permitted by federal, state and local laws, such as hiking, fishing, picnicking, and similar uses. Construction of unimproved, pervious trails less than five feet wide that are no closer than 125 feet from the edge of the stream to further such passive recreation uses is also permitted, as are river access points. However, trails that become damaged due to natural erosion shall not be repaired but shall be moved upland or removed altogether.

    2. Removal of Damaged or Diseased Trees. Damaged or diseased trees may be removed. Due to the potential for felled logs and branches to damage downstream properties and/or block watercourses or otherwise exacerbate flooding, logs and branches resulting from the removal of damaged or diseased trees that are greater than six (6)-inches in diameter at the cut end shall be cut into sections no longer than six (6)-feet, anchored to the shore or removed.

    3. Revegetation and/or Reforestation. Revegetation and/or reforestation of the riparian setback will be permissible using species identified in Table 1. Table 1 lists species of plants and shrubs recommended for stabilizing flood prone areas. Proper selection of species is dependent on soil conditions, available water and

amount of sun exposure. Proper species selection will take into account these factors.

Table 7-1. Species of Plants & Shrubs Recommended for Stabilizing Flood Prone Areas

Riparian Corridor- Trees

Botanical Name	Common Name
Acer spp.	Maple(s)
Betula nigra	River Birch
Carya spp.	Hickory(s)
Celtis occidentalis	Common hackberry
Cercis canadensis	Eastern redbud
Crataegus phaenopyrum	Washington hawthorne
Crateaegus crusgalli	Cockspur hawthorne
Fagus grandiflora	Beech
Gleditsia triacanthos	Honeylocust
Hamamelis virginiana	Common witchhazel
Liriodendron tulipifera	Tulip poplar
Liquidambar styraciflua	Sweetgum
Platanus occidentalis	Sycamore
Populus deltoids	Eastern cottonwood
Prunus serotina	Black cherry
Quercus alba	White oak
Quercus palustris	Pin oak
Quercus rubra	Red Oak
Ulmus rubra	Slippery elm

Riparian Corridor- Shrubs

Botanical Name	Common Name
Aronia melanocarpa	Black chokeberry
Cornus racemosa	Gray dogwood
*Cornus stolonifera**	Red-osier dogwood
Lindera benzoin	Spicebush
*Salix spp.**	Willow(s)
Sambucus canadensis	Elderberry
Viburnum dentatum	Southern arrowwood
Viburnum prunifolium	Blackhaw viburnum
Viburnum lentago	Nannyberry viburnum
Viburnum trilobum	American cranberrybush

*Instream plantings for rapid shade cover and bank stabilization.

4. Public Utilities. Sanitary sewer, storm sewer, and/or water lines and public utility transmission lines may be located within the SCPZ and disturbances of the SCPZ necessary to place and/or maintain such utilities are also authorized. The placement, construction and maintenance of such utilities shall minimize disturbance to riparian areas and shall mitigate any necessary disturbances. The developer and/or landowner shall secure the appropriate state and federal permits required for installation of the specific utility(s). Utilities that are parallel to the stream shall not be constructed or placed within the SCPZ.

5. Public Roadways. Public roadways may cross the SCPZ and disturbances of the SCPZ necessary to place and/or maintain the roadways are authorized. The placement, construction and maintenance of the roadway shall minimize disturbance to riparian areas and shall mitigate any necessary disturbances. There shall be no more than two roadway crossings of the setback within any proposed development. The developer and/or landowner shall secure the appropriate state and federal permits required for watercourse impacts attributed to this activity.

6. Construction activities associated with permitted stream restoration projects.

7. Disturbances resulting from permitted stream and/or wetland mitigation projects.

8. "Emergency Channel Maintenance Activity" may be authorized by the City Engineer, as needed, to restore and/or maintain the flood carrying capacity of the main channel area. Such activity may include, but not be limited to, removal of trees or brush or the accumulation of sediment in the main channel as necessary to restore flood flow carrying capacity of the main channel.

b. Conditional Uses. These uses are not explicitly permitted but may be allowed subject to review and approval of the City. The City's review of these activities will consider the extent to which disturbances will occur within the SCPZ and how those disturbances will be mitigated. A conditional use activity will be denied by the City if it is found to be inconsistent with the need to protect the stream channel from impacts that impair water quality and or channel stability, or if the activity may require future maintenance that would further disturb the SCPZ.

    1. Streambank stabilization/erosion control work. Localized or large-scale stream channel and riparian buffer restoration work that is ecologically compatible with the surrounding features and substantially uses natural and native materials.

    2. Construction of paved (asphalt) or unpaved (gravel) trails to further passive recreation uses. Such trails that become damaged due to natural erosion shall not be repaired, but shall be relocated upland and outside of the SCPZ. Specific conditions applicable to paved trails can be found in the Appendix 9-3 of the Section 208 Plan.

    3. A driveway or non-arterial roadway. This activity is limited to projects where the proposed roadway is the only access for the parcel and/or the roadway provides some ecological protection to surrounding areas by preserving existing ecologically sensitive areas.

c. Prohibited Uses. Any use not authorized under these regulations shall be prohibited in the SCPZ. The following is a list of specific uses prohibited in the SCPZ, but is not inclusive of all uses prohibited in the SCPZ:

    1. Construction. There shall be no structures of any kind except as required for the permitted or conditional uses listed previously.

2. Dredging or Filling. There shall be no drilling, filling, dredging, grading, or dumping of soils, spoils, liquid or solid materials. No floodplain fill permits will be granted for areas within the SCPZ except those that are required for activities listed as permitted uses.

3. Motorized Vehicles. There shall be no use of motorized vehicles except as needed for activities associated with the permitted uses listed previously

4. Parking Lots. There shall be no parking lots or other man-made impervious cover.

5. Stormwater Detention Facilities. Stormwater detention facilities may be located adjacent to, but not within the SCPZ.

6. Watercourse Enclosures: No open channels (natural or man-made) in the SCPZ will be enclosed within a storm sewer or conduit.

7. Developed or Platted Lots. No part of any lot to be developed or platted will be located within the SCPZ.

d. Non-conforming Uses and Structures within the SCPZ.

1. Any pre-existing non-conforming use within a SCPZ may be continued, but shall not be changed to a new use or enlarged unless changed to a use permitted under this regulation.

2. A non-conforming use within a SCPZ may be continued, but shall not have the existing building footprint or roofline expanded or enlarged.

3. A non-conforming use within a SCPZ that has substantial damage and that is discontinued, terminated, or abandoned for a period of six (6) months or more may not be revived, restored or re-established.

7.1.3.5 Maintenance of the Stream Corridor Protection Zone

a. Disturbance of Natural Vegetation. There shall be no disturbance of the natural vegetation at any time, including during construction of the remainder of the site, except for such conservation maintenance that the landowner and the City deem necessary to control noxious weeds; for such plantings as are consistent with the guidance in this Manual for removal of invasive species and their replacement with native vegetation.

b. Recommended Vegetation for Stabilizing Flood prone Areas. Proper selection of species for stabilization of flood prone areas is dependent on several factors, including soil conditions, available water and amount of sun exposure. Proper species selection and installation will take into account these factors. A list of appropriate plant species is given in Table 1.

7.1.4 Drainage Easements

In order to provide access for City personnel for inspection and maintenance, the Developer is required to procure and convey to the City an easement for any tile, pipe, detention basin, drainage way, flood routing path, ditch, watercourse, natural stream, man-made stream, storm sewer, or other stormwater component or facility not already within the City right-of-way. The easement must be of sufficient width to allow cleaning, widening, deepening, replacing or other general maintenance of such drainage course or piped system. The Owner and/or Developer must meet the requirements detailed below with regard to the procurement, execution, and maintenance of the Easement.

a. Easements of at least six feet in width shall be provided on each side of all rear lot lines and along side lot lines where necessary, for poles, wires, conduits, and gas mains. Easements may also be required along or across lots where engineering design or special conditions may necessitate the installation of water and sewer lines outside public rights-of-way. For lots facing on curvilinear streets the rear easement should consist of straight lines with a minimum number of points of deflection.
b. When it is necessary to convey stormwater outside the property lines of a proposed improved area in order to discharge into an adequate outlet, the Developer:
    1. is required to obtain easements and/or maintenance agreements, in a form and substance satisfactory to the City Engineer, from abutting property owners, and

    2. is responsible for maintenance agreements for such drainage course unless the easements and/or maintenance agreements require the abutting property owners to repair and maintain the drainage course satisfactorily.

All drainage easements, preservation areas, reserves and other similar areas must be shown on the "final engineering and construction plan(s)". Drainage easements for all on-site drainage system improvements shall be recorded for public use by final plat and deed. For off-site drainage system improvements, easements should be recorded for public use by either final plat or separate instrument. The maintenance of such drainage easements shall be undertaken in the manner set forth in Section 4.10, below.

7.2 STORMWATER RUNOFF CONTROL CRITERIA

Post-construction and construction stormwater control criteria within the City of Hilliard differ for areas located within the Big Darby Watershed. Sections 2.1 and 2.2, below, represent the general stormwater control criteria which are applicable to all areas within the City limits. Section 2.3 references the additional control criteria required for developing areas within the Big Darby Creek Watershed. The OEPA recommends that stormwater management practices meet the standards and specifications in the most current edition of the Rainwater and Land Development Manual provided by the Ohio Department of Natural Resources (ODNR).

7.2.1 Quantitative Control

Stormwater runoff control shall address both peak rate and total volume of runoff. The peak rate of runoff from an area after development shall not exceed the peak rate of runoff from the same area before development for all storms from one year up to a 100-year return frequency storm. In addition, if it is found a proposed development will increase the volume of runoff from an area, the peak rate of runoff from certain more frequent storms must be controlled further. There are two reasons why increases in volume of runoff require a control standard more restrictive than controlling to the predevelopment condition. First, increases in volume mean runoff will be flowing for a longer period of time. When routed through a watershed, these longer flows may join at some point or points downstream thereby creating new peak flows and problems

associated with peak flow (flooding and erosion). This is known as the "Routing Problem". Second, longer flow periods of large runoff quantities place a highly erosive stress on natural channels. This stress can be minimized by reducing the rate of discharge. The permissible peak rate shall be determined as follows:

a. For the purpose of determining the critical storm for all projects and allowable peak flow rates for all projects other than redevelopment projects, a maximum runoff curve number of 77 shall be used. Areas with land use and soil types that correlate to a runoff curve number less than 77 shall use the lower runoff curve number for all pre-developed calculations, see Table 7-3 for runoff curve number values.
b. Determine the total volume of runoff from a 1-year frequency 24-hour storm, occurring over the area both before and after development.

c. Determine the percentage of increase in volume due to development and using this percentage, pick the critical storm from Table 2.

d. The peak rate of runoff from the critical storm occurring over the development shall not exceed the peak rate of runoff from a 1-year frequency storm occurring over the same area under predevelopment conditions. Storms of less frequent occurrence (longer return period) than the critical storm, shall have a peak rate of runoff not greater than for the same storm under predevelopment conditions. As an example, if the total volume is to be increased by 35%, the critical storm is a 5-year storm. The peak rate of runoff for all storms up to this intensity shall be controlled so as not to exceed the peak rate of runoff from a 1-year frequency storm under predevelopment conditions in the area. The runoff from a more intense storm up to a 100-year storm need only be controlled so as not to exceed the predevelopment peak rate from the same frequency of storm.

Table 7-2. Critical Storm for Stormwater Volume Calculations

If the percentage of increase in VOLUME [of] runoff is		The Critical Storm for discharge limitations will be:
Equal to or greater than	and less than	
--	10	1 year
10	20	2 year
20	50	5 year
50	100	10 year
100	250	25 year
250	500	50 year
500	--	100 year

e. For the purpose of determining the pre-development and post development peak flow rates, calculate the curve numbers using Table 7-3. The pre-developed runoff curve number determination for both new development and redevelopment projects shall be based upon the project area current land use.

Table 7-3: NRCS Runoff Curve Numbers[1]

Description of Land Use	Hydrologic Soil Group			
	A	B	C	D
Paved parking lots, roofs, driveways	98	98	98	98
Streets and Roads:				
Paved with curbs and storm sewers	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89
Cultivated (Agricultural Crop) Land*:				
With or without conservation treatment (terraces, contours)	62	71	78	81
Pasture or Range Land:				
Poor (<50% ground cover or heavily grazed)	68	79	86	89
Good (50-75% ground cover; not heavily grazed)	39	61	74	80
Meadow (grass, no grazing, mowed for hay)	30	58	71	78
Brush (good, >75% ground cover)	30	48	65	73
Woods and Forests:				
Poor (small trees/brush destroyed by over-grazing or burning)	45	66	77	83
Fair (grazing but not burned; some brush)	36	60	73	79
Good (no grazing; brush covers ground)	30	55	70	77
Open Spaces (lawns, parks, golf courses, cemeteries, etc.):				
Fair (grass covers 50-75% of area)	49	69	79	84
Good (grass covers >75% of area)	39	61	74	80
Commercial and Business Districts (85% impervious)	89	92	94	95
Industrial Districts (72% impervious)	81	88	91	93
Residential Areas:				
1/8 Acre lots, about 65% impervious	77	85	90	92
1/4 Acre lots, about 38% impervious	61	75	83	87
1/2 Acre lots, about 25% impervious	54	70	80	85
1 Acre lots, about 20% impervious	51	68	79	84

[1] **Chow et al. (1988)**

7.2.2 Qualitative Control

Stormwater qualitative control must be implemented into sites in accordance with general and specific requirements outlined in the current version of the OEPA's permit for stormwater discharges associated with construction activity or any subsequent OEPA-issued revision.

7.2.2.1 Large Construction Sites

For all construction activities (involving the disturbance of five or more acres of land or will disturb less than five acres, but is a part of a larger common plan of development or sale which will disturb five or more acres of land), the post construction Best Management Practice (BMP) chosen must be able to detain stormwater runoff for protection of the stream channels, stream erosion control, and improved water quality. Structural (designed) post-construction stormwater treatment practices shall be incorporated into the permanent drainage system for the site.
Water Quality Volume (WQv): The selected BMP(s) must be sized to treat the water quality volume and ensure compliance with Ohio's Water Quality Standards in Ohio Administrative

Code (OAC) Chapter 3745-1. The WQv shall be equivalent to the volume of runoff from a 0.75-inch rainfall and must be determined according to one of the two following methods.

a. Through a site hydrologic study approved by the local City permitting authority that uses continuous hydrologic simulation and local long-term hourly precipitation records or;

b. Using the following equation:

WQv = C * P * A / 12

where:
WQv = water quality volume in acre-feet

C = runoff coefficient appropriate for storms less than 1 inch (see Table 3)
P = 0.75 inch precipitation depth
A = area draining into the BMP in acres

Table 7-4. Runoff Coefficients Based on the Type of Land Use

Land Use	Runoff Coefficient
Industrial & Commercial	0.8
High Density Residential (>8 Dwellings/Acre)	0.5
Medium Density Residential (4 To 8 Dwellings/Acre)	0.4
Low Density Residential (<4 Dwellings/Acre)	0.3
Open Space And Recreational Areas	0.2

Where the land use will be mixed, the runoff coefficient should be calculated using a weighted average. For example, if 60% of the contributing drainage area to the storm water treatment structure is low density residential, 30% is high density residential, and 10% is open space, the runoff coefficient is calculated as follows (0.6)(0.3) + (0.3)(0.5) + (0.1)(0.2) = 0.35.

An additional volume equal to 20 percent of the WQv shall be incorporated into the BMP for sediment storage and/or reduced infiltration capacity. OEPA recommends that BMPs be designed according to the methodology included in the Rainwater and Land Development manual or in another design manual acceptable for use by OEPA.

BMPs shall be designed such that the drain time is long enough to provide treatment, but short enough to provide storage available for successive rainfall events. The outlet structure for the qualitative control is to be designed to meet the minimum total WQv drain times as indicated within the OEPA General Permit and/or Big Darby Creek permit. The outlet control shall provide a total minimum WQv drain time as indicated within Table 7-5. The outlet structure shall additionally not discharge more than the first half of the WQv in less than one-third of the minimum total drain time.

Table 7-5. Target Draw Down (Drain) Times for Structural Post-Construction Treatment Control Practices

	Drain Time of WQv
Infiltration Basin or Trench	48 Hours
Permeable Pavement – Infiltration	48 Hours
Permeable Pavement – Extended Detention	24 Hours
Extended Detention Basin (Dry Basins)	48 Hours
Extended Detention Basin Basin (Wet Basins)	24 Hours
Constructed Wetland (above Permanent Pool)	24 Hours
Sand & Other Media Filtration, Bioretention	24 Hours

The permittee may request approval from the City Engineer or designee and OEPA to use alternative structural post-construction BMPs. The permittee must demonstrate that the alternative BMPs are equivalent in effectiveness to those listed in Table 7-4, above. New construction activities shall be exempt from this condition if it can be demonstrated that the WQv is provided within an existing structural post-construction BMP, located downstream, that is part of a larger common plan of development, before being released into an open watercourse.

For redevelopment projects (i.e., developments on previously developed property), post-construction practices shall either ensure a twenty (20) percent net reduction of the site impervious area, provide for treatment of at least (20) percent of the WQv or a combination of the two.

7.2.2.2 Small Construction Sites

For all small land disturbance activities (which disturb one or more, but less than five acres of land and which are not a part of a larger common plan of development which will disturb five or more acres of land), a description of the measures that will be installed during the construction process to control pollutants in stormwater discharges that will occur after the construction operations have been completed must be included in the Stormwater Pollution Prevention Plan (SWP3). Practices may include but are not limited to stormwater detention storage (including wet basins), stormwater retention, flow attenuation by use of open vegetated swales and natural depressions, infiltration of runoff onsite, and sequential systems which combine several practices. The SWP3 shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed pre-development levels.

Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected.

7.2.3 Stormwater Control Criteria Specific to Big Darby Creek Watershed

The stormwater control criteria and design requirements applicable to the entire Big Darby Creek watershed are specified by the OEPA in the current edition of the General Permit for Stormwater Discharges Associated with Construction Activity Located within the Big Darby Creek Watershed notwithstanding any of the requirements of the City of Hilliard, the applicant is responsible for adhering to all of the Ohio EPA's criteria and obtaining a signed Notice of Intent (NOI), along with an approved SWPPP including documentation of post-construction water quality features, from the OEPA.

7.3 STORMWATER SYSTEM GENERAL DESIGN CRITERIA

7.3.1 Design Storms

a. The initial/minor drainage system is that part of the storm drainage system which is used regularly for collecting, transporting, and disposing of stormwater runoff from frequent and low magnitude storm events, snowmelt, and miscellaneous minor flows. The capacity of the initial drainage system should be equal to the maximum rate of runoff expected from a design storm of established frequency (i.e., Initial Storm). For purposes of design, the initial drainage system portion of the overall storm drainage system shall be designed to contain the runoff from a storm with a return period of not less than five-years.

b. The major drainage system is that part of the storm drainage system which carries the runoff which exceeds the capacity of the initial drainage system. The major drainage system shall have the capacity to carry runoff from a storm with a return period of not less than 100-years (i.e., Major Storm) without posing significant threat to property or public safety.

c. All conveyances and conduits containing a stream (permissible only through granting of a waiver (refer to Section 1.3) shall have the capacity to carry a minimum of a 10-year design storm from the entire upstream drainage area. In addition, a flood routing flow path shall be included to carry the major storm flow as defined in Section 3.3 of this manual (100-year storm). This flood routing path must be clearly shown on the site development plans, and the applicant shall provide storm water calculations for the proposed enclosure and flood routing path to the City of Hilliard for approval.

7.3.2 Initial Storm – Physical Design Criteria for On-Site Improvements

a. Depth of flow in man-made ditches or swales shall not exceed 80% of the channel depth. Velocity of flow shall be determined in accordance with the design criteria for open channels in Section 4.4 c.3., and shall not exceed 5 feet per second, or a rate determined by the City Engineer to be detrimental to the watercourse. Where flows exceed this velocity rate, special channel lining and erosion protection shall be provided.

b. Depth of flow in road-side ditch swales shall not exceed one foot or be of such depth that flow would extend out of the right-of-way if the side ditch is less than one foot in depth. Velocity at this depth shall not exceed six feet per second for grass swales or ten feet per second for paved ditches.

c. Depth of flow in streets with curb and gutter shall not exceed the curb height. Velocity of flow in the gutter at design depth shall not exceed ten feet per second. In addition to the above, the following are maximum encroachments of the initial storm onto the pavement. See Section 4.3 for specific design criteria for curb inlet design.

    4. For minor streets carrying traffic from the individual residence to collector and secondary streets, the flow may spread to the crown of the street.

    5. For collector and secondary streets, one lane shall be free from water.

    6. For primary streets, one lane in each direction shall be free from water.

    7. For freeways, no encroachment is allowed on traffic lanes.

d. In design of a storm sewer pipe conduit, the conduit may be designed on the basis of flowing full with surcharge to gutter line. Backwater effects must be considered.

7.3.3 Major Storm – Physical Design Criteria for On-Site Improvements

a. The major storm floodway and floodway fringe for natural streams shall be as defined by the Federal Emergency Management Agency (FEMA), U.S. Army Corps of Engineers, the Ohio Department of Natural Resources, or where such determinations have not been made by these agencies, the major storm floodway and floodway fringe for natural streams may be estimated through a technical analysis by a registered Professional Engineer in the State of Ohio, in a manner found acceptable by the City of Hilliard.

b. Many of the drainage ways associated with the major storm system are in areas beyond those designated as floodway or floodway fringe. For these areas, the major storm flood limits shall be determined by the U.S. Army Corps of Engineers' HEC-RAS model or other accepted methods of determining water profiles using the major design storm runoff. Six (6)-inches of elevation must be added to the flood profile as freeboard to provide protection in the event of future encroachments into the floodway fringe or in the drainage way.

c. Compatible multiple-purpose designs for non-street drainage-ways are encouraged. Pedestrian paths and linear parks are effective uses for drainage-ways.

d. Where the street is designed as the major drainage system, the depth of flow shall not exceed twelve (12)-inches at gutter line for minor, collector and secondary streets, and shall not exceed six (6)-inches depth at crown for primary streets and freeways. The same maximum depth criteria will apply where a major drainage way crosses the street. Where a major drainage way is located outside the street, stormwater management easements will be provided over the drainage way.

e. In determining the required capacity of surface channels and other drainage ways provided for the major storm runoff, the street storm inlets and conduit provided for the initial storm may be assumed to carry a portion of the total runoff volume, if appropriate. The following equation shall be used to determine the required capacity of surface channels and drainage ways in their design, when a portion of the runoff is conveyed within the initial piped system:

$$Q_{100} = C\ I_{10} A + 0.96 (I_{100} - I_{10}) A$$

and

$$Q_{\text{flood routing path}} = Q_{100} - Q_{\text{pipe}}$$

Where:

$Q_{\text{flood routing path}}$ = Design flow, major storm runoff (cfs)
Q_{pipe} = Peak flow within piped system (i.e., 5-year event) (cfs)
Q_{100} = Peak flow for 100-year event (cfs)
C = Rational runoff coefficient, site developed condition
I_{10} = rainfall intensity for 10-year storm event (inches/hour)
I_{100} = rainfall intensity for 100-year storm event (inches/hour)
A = Drainage area contributory to design point (acres)

f. All grassed waterways utilized as major drainage ways shall have a minimum channel slope of one percent (1.0%). Channel slopes flatter than this minimum must be approved by the City Engineer.

7.3.4 Methods of Calculation

The following methods of calculation shall be used unless otherwise approved by the City Engineer:

a. Rainfall volumes shall be in accordance with data for Central Hilliard, Ohio provided in per "Bulletin 71: Rainfall Frequency Atlas of the Midwest", 1992 NOAA Atlas 14 Precipitation-Frequency Atlas of the United States, Volume 2, Version 3.0" and any subsequent updates thereto.

b. Rainfall distribution for stormwater management systems is to be in accordance with SCS Type II Rainfall Distribution.

c. The appropriate Runoff Curve Number (i.e., "RCN" factor) may be determined by using Technical Release No. 55 (S.C.S.) or its Ohio Supplement.

7.3.5 Drainage Area Determination

The drainage area shall be determined from any of the following sources, which are listed in order of priority preference:

a. Actual field investigation;

b. County Auditor, topographic maps;

c. U.S. Geological Survey quadrangle (7.5 minute series) contour maps;

d. Soil Survey of Franklin County, Ohio, U.S.D.A.

7.4 STORMWATER SYSTEM SPECIFIC DESIGN SPECIFICATIONS

7.4.1 Roadway Culverts

a. General specifications. The size and shape of the culvert should be such that it will carry a predetermined design peak discharge need to specify without the depth of water at the entrance or the velocity at the outlet exceeding allowable limits.

b. Design procedure. The culvert design procedure recommended for use is Hydraulic Design Series No. 5, U.S. Department of Transportation. http://www.fhwa.dot.gov/engineering/hydraulics/library_listing.cfm (publication code HDS 05)

c. Preferred construction. Single span culverts, including concrete box and slab top are preferred. Multiple cell pipe culverts, when they are the only structures that will meet the physical requirements introduced by rigid headwater controls, will be permitted.

d. Material**.** The culvert material shall be concrete, at a minimum diameter of 12 inches. Corrugated steel or metal pipe material will not be permitted.

e. Drainage area. The drainage area in acres, the estimated runoff or design discharge in cubic feet per second, and the storm frequency in years shall be shown on the plan for each culvert.

f. Inlet elevation. The flowline elevation at the culvert inlet should be set deep enough to provide an adequate outlet for future storm sewer improvements upstream.

g. Design storm frequency (roadway culverts), shall be:

1. 10-year frequency 24-hour storm event for private drives, local and collector streets.
2. 25-year frequency 24-hour storm event for arterial streets.

h. Design flow. For method of calculation, refer to Table 5.

i. Maximum allowable headwater. The maximum allowable headwater for the design storm shall not exceed or cause any of the following:
1. 18-inches below the top of curb
2. 12-inches below the edge of pavement
3. 1.2 times the diameter of culvert
4. Diameter or rise plus two feet, in deep ravines
5. Property Damage – 100-year frequency headwater plus 1-foot, shall not exceed any existing or proposed building first floor elevation

Table 7-6. Acceptable Methods of Calculation for Design Flow in Roadway Culverts

DRAINAGE AREA (ACRES)	STORMWATER QUANTITY				
	PEAK DISCHARGE ONLY	PEAK DISCHARGE AND TOTAL RUNOFF VOLUME		STORAGE VOLUME	
		HOMOGENEOUS LAND USE	NON-HOMOGENEOUS	HOMOGENEOUS LAND USE	NON-HOMOGENEOUS
LESS THAN 200	RATIONAL OR PEAK DISCHARGE	PEAK DISCHARGE	(*) TABULAR HYDROGRAPH	GRAPHICAL	(*) STORAGE-INDICATION
200 TO 300	PEAK DISCHARGE				
GREATER THAN 300	(*) TABULAR HYDROGRAPH			(*) STORAGE-INDICATION	

*Note: The "Tabular Hydrograph" and "Storage-indication" methods are preferred and are normally used to check drainage calculations submitted to the City Engineer

Method References:

Rational: (Q = CIA); MORPC, Stormwater Design Manual, 1977

Graphical: Ibid., Pg. 143

Peak Discharge: U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, 1986

Storage– Indication: MORPC, Stormwater Design Manual, 1977, Pg. 143.

SCS TR-20 and US Army COE HEC-1

Tabular Hydrograph: SCS TR-55, Chap. 5 SCS TR-20, US Army COE's HEC-1

USGS regression equations for Central Ohio may be used where applicable, for estimating peak flows for culvert design and to estimate peak release rates.

j. Manning's roughness coefficient (n). Manning's Roughness Coefficient (n) should be as given in Table 6 unless an alternate value is approved by the City Engineer.

k. Entrance loss coefficient (Ke). The Entrance Loss Coefficient (Ke) should be as given in Table 6 based upon the headwall configuration unless an alternative value is approved by the City Engineer.

Table 7-7. Design Coefficients for Roadway Culverts

TYPE STRUCTURE	MANNING'S ROUGHNESS COEFFICIENT (n)	ENTRANCE LOSS COEFFICIENT (Ke)*
CONCRETE PIPE	0.013	0.2
BOX: 4-sided BOX: 3-sided	0.013 weighted by wetted perimeter minimum 0.018	0.2 TO 0.5 0.2 TO 0.5
SLAB TOP	0.03 TO 0.05	0.2 TO 0.5

* As a function of the headwall configuration

l. Minimum cover to subgrade. Should be 30 inches from top of pipe to subgrade.

m. Maximum allowable outlet velocity, shall be:
   1. Turf Channel 5 f.p.s.
   2. Rock Protection 18 f.p.s

   Notes:
   - When the outlet velocity exceeds 18-feet per second, a stilling basin or other such energy dissipation structure must be used.
   - The downstream channel must have the ability to handle the flow satisfactorily.

n. Structural design criteria. The structural design criteria for culverts shall be the same as that required by the Ohio Department of Transportation (ODOT).

o. Emergency flood routing. The emergency flood routing shall be capable of routing the 100-year storm over or around the culvert without creating a hazard or causing potential for erosion or personal property damage. Adequate scour protection must be included in the design.

p. End protection should be as follows:
   1. 12-inch through 36-inch culverts – full-height headwall
   2. 42-inch through 84-inch culverts – full height headwall with flared wings
   3. Other special type headwalls must be approved before use

7.4.2 Storm Sewers

The criteria for designing storm sewer systems are listed below:

a. All storm sewer systems shall be designed using Manning's Equation:

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

and

$$Q = AV$$

where:

Q = Rate of discharge (cfs)
A = Area of cross-section of flow (sq.ft.)
V = Mean velocity of flow (fps)
n = Manning's roughness coefficient
R = A/wp = Hydraulic radius (ft)
S = Slope of pipe or hydraulic grade line if surcharged (ft/ft)
wp = Wetted perimeter (ft)

b. Design Storm Frequency shall be:
   1. 72" and under - flowing full for 2-year storm
   2. Over 72" diameter - flowing full for 10-year storm

c. Hydraulic Gradient Requirement shall be:
   1. Based on a 5-year storm, shall not exceed window or grate elevation for an inlet or catch basin.
   2. Grade line based on tailwater or 0.8 D at outlet (whichever is greater) or other critical points within the system.

d. Design Flow Determination:
   1. Areas under 200 acres use Rational Method Q = CiA
   2. Areas between 200 and 300 acres transition between Rational Method and Technical Release 55
   3. Areas over 300 acres use Technical Release 55
   4. Minimum times of Concentration:
      - Curb inlet - 10 minutes
      - Catch basin - 15 minutes

e. Runoff Coefficient
   1. Based on Table 7, with 0.4 as a minimum.

f. Manning's "n" Value
   1. All storm sewers shall be based on an "n" of 0.010 to 0.013.

g. Off-site Area: The sewer must be deep enough to receive the flow from all its sources within the watershed.

h. Size: The size of the sewer must be adequate for flowing full, based on the design storm (see Subsection 4.2 b., listed above) with the 5-year storm hydraulic grade line contained to the system. A minimum pipe size of 12-inch diameter shall be required for all City of Hilliard maintained sewers.

Table 7-8: Runoff Coefficients "C" for Typical Land Uses in Columbus

Cover Type and Hydrologic Condition	Average percent impervious area (5)	Runoff Coefficient for Hydrologic Soil Group (7) A	B	C	D
Fully developed urban areas (vegetation established) (1)					
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		0.94	0.94	0.94	0.94
Open space (lawns, parks, golf courses, cemeteries, etc)					
Poor condition (grass cover, 50%)		0.29	0.48	0.63	0.70
Fair condition (grass cover 50% to 75%)		0.07	0.30	0.48	0.58
Good condition (grass cover >75%)		NA	0.19	0.39	0.50
Commercial and business (TND – TC) (6)					
Industrial					
Residential Districts by Average Lot Size (6):					
Multi-family (TND – NC)	80	0.63	0.75	0.80	0.83
1/12 to 1/6 acre lots (TND – NG)	75	0.56	0.70	0.77	0.83
1/8 acre (TND – NE)	65	0.44	0.60	0.72	0.77
1/4 acre	38	0.19	0.40	0.56	0.65
1/2 acre	25	0.11	0.32	0.50	0.60
1 acre	20	0.08	0.29	0.48	0.58
Undeveloped or agricultural lands(1)					
Cultivated Land:					
Without conservation treatment		0.35	0.52	0.67	0.75
With conservation treatment		0.21	0.34	0.46	0.52
Pasture, grassland, or range – continuous forage for grazing. (2)	Hydrologic condition:				
	Poor	0.29	0.48	0.63	0.70
	Fair	0.07	0.30	0.47	0.58
	Good	NA	0.19	0.39	0.50
Meadow – continuous grass, protected from grazing and generally mowed for hay.		NA	0.16	0.34	0.46
Brush – brush-weed-grass mixture with brush the major element. (3)	Poor	0.06	0.27	0.44	0.56
	Fair	NA	0.13	0.37	0.48
	Good	NA	0.06	0.25	0.37
Woods. (4)	Poor	0.04	0.26	0.44	0.56
	Fair	NA	0.18	0.37	0.48
	Good	NA	0.12	0.32	0.44
Farmsteads – buildings, lanes, driveways, and surrounding lots.	--	0.17	0.39	0.54	0.63

Notes:

NA – Method to derive value is not applicable for curve number values less than 40.

(1) Average runoff condition, and Ia=0.2s.

(2) Poor: <50% ground cover or heavily grazed with no mulch; Fair: 50 to 75% ground cover and not heavily grazed; Good: >75% ground cover and lightly or only occasionally grazed.

(3) Poor: <50% ground cover; Fair: 50 to 75% ground cover; Good: >75% ground cover.

(4) Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning; Fair: Woods are grazed but not burned, and some forest litter covers the soil; Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

(5) The average percent impervious area shown was used to develop the composite CN's which were then used to derive runoff coefficient values. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a runoff coefficient of 0.94 (or CN of 98), and pervious areas are considered equivalent to open space in good hydrologic condition.

(6) Acronyms for zoning of residential districts are as follows:
TND – TC: Traditional Neighborhood Development – Town Center; TND – NC: Traditional Neighborhood Development – Neighborhood Center; TND – NG: Traditional Neighborhood Development – Neighborhood General; TND – NE: Traditional Neighborhood Development – Neighborhood Edge

(7) These runoff coefficients were calculated from CN's drawn from the NRCS (SCS) Peak Discharge Method from TR-55 assuming a 10-year, 24-hour storm. For larger design storms, the runoff coefficients should be increased using the following C value correction factors: 1.0 for the 10-year design storm and less; 1.1 for the 25-year design storm; 1.2 for the 50-year design storm;

1.3 for the 100-year design storm

i. Solids: The gradient of the sewer must be sufficient to avoid deposition of solids.

j. Material: The storm sewer material for City maintained sewers shall be reinforced concrete, per Item 706.02 or smooth-lined corrugated polyethylene pipe per Item 720.12 of City of Columbus "Construction and Materials Specifications latest Edition. 8-inch through 15-inch PVC or high density polyethylene may be used on privately maintained storm sewers. Other material may be used for special design, only if approved for use by the City Engineer. Corrugated metal or steel material will not be permitted.

k. Manholes: The main conduit, if over 24-inches in diameter, will be required to be separated from all curb and gutter inlets unless a special design is approved by the City Engineer. Furthermore, the main conduit will be required to be separated from all deep curb and gutter inlets, which have a depth greater than 6.5 feet from the invert to the top-of-casting elevation. No storm sewer will be constructed parallel to and underneath curb and gutter.

l. Flow Line: Unless otherwise approved by the City Engineer, the flow line of pipes should be set such that the crown of pipes, at junctions, are at the same elevation. If the outlet elevation permits, the crown of the outlet pipe may be lower. The flowline elevations of sewers should be set to avoid using concrete encasement. No storm sewer will be constructed parallel to and underneath curb and gutter.

m. Specifications: Methods of construction and trench backfill shall be as per the requirements of the City of Hilliard and the City of Columbus "Construction and Materials Specifications", latest edition, as approved for use by the City Engineer.

n. Submerged pipe outlets: The submergence of a permanent pool of water above the flowline invert elevation of a storm sewer at the outlet is discouraged and shall not be permitted to a depth greater than one-half (½) the pipe diameter or to a depth of two-feet at the outlet, whichever is less. When submergence is allowed upon approval by the City Engineer, special requirements shall include, but may not be limited to:

    1. Submergence "zone" shall not extend beneath pavement;

    2. Submergence "zone" shall not extend beyond the first manhole;

    3. "O-ring" sealed gasketed pipe joints shall be installed along the storm sewer for the full length of the submergence "zone";

    4. Anti- seepage collars shall be installed in the submergence "zone".

o. End protection should be as follows:

    1. 12-inch through 36-inch culverts – full-height headwall. If the outlet is not located within a channel bank or within the direct flow path of crossing floodwaters, half-height-headwalls at the outlet may be used if approved by the City Engineer. Half-height-headwalls will not be permitted on non-concrete conduits.

    2. 42-inch through 84-inch culverts – full height headwall with flared wings

    3. Other special type headwalls must be approved before use

p. Minimum cover to subgrade:

1. Desirable, under pavement and within influence of traffic load - 30 inches from top of pipe to subgrade.

2. Desirable, beyond influence of traffic load – 18 inches from top of pipe to ground surface.

q. Maximum cover over pipe:

1. The supporting strength of the conduit, as installed, divided by a suitable factor of safety must equal or exceed the loads imposed upon it by weight of earth plus any superimposed loads.

2. The design procedure recommended for use in structural design of storm sewers is outlined within the Design Manual Concrete Pipe, available from American Concrete Pipe Association, wide trench installation. http://www.concrete-pipe.org/designmanual.htm

r. Encasement: Class A concrete encasement shall be required within the limits of existing or proposed paved areas inside right of way, in areas influenced by traffic loading, or under paved driveway entrances adjacent to right of way as directed by the City Engineer, where the minimum cover during construction or proposed cover over the outside top of the pipe to top of subgrade is 30 inches or less. Any concrete encasement of flexible pipe shall extend from structure to structure.

s. Velocity in sewer for design flow:

1. 3 fps Minimum

2. 15 fps Maximum

3. No minimum for outlets from ponding areas

t. Maximum Length between access structures:

1. Pipes under 60-inch – 350 feet

2. Pipes 60-inch and over 500 feet

7.4.3 Curb Inlets

a. General: The satisfactory removal of surface water from curbed pavement is as important as any other phase of stormwater control. The spread of water on the pavement for the design storm is considered as the best control for pavement drainage. The design procedure recommended for use is FHWA Hydraulic Engineering Circular No. 12, available from the Superintendent of Documents, U.S. Government Printing Office. On combined runs of over 600 feet contributing to a sag vertical curve, an additional inlet may be required near the low point, plus or minus two-tenths foot above the inlet at the sag.

b. Design storm (curb inlets). The following shall be used:

1. Two-year storm frequency

2. Rational method of calculation

3. Ten minutes for minimum time of concentration

4. 0.015 for roughness coefficient for composite roadway paved and gutter section

5. Maximum width of spread of flow:

Street Width (F/C to F/C)	Width of Spread
≤ 26 ft.	8 ft.
> 26 ft.	9 ft.

c. Underdrains: Four (4)-inch curb drain connections shall be placed 30-inches below the top of the curb on the up-grade side of the inlet. It is desirable to have the storm sewers, draining to the inlets, set such that the elevation of the top of the sewer is not higher than the top of the 4-inch curb drain.

7.4.4 Open Water Courses

a. General Requirements. The requirements in this section are applicable to newly constructed open watercourses that are intended to convey flow to stormwater inlets, stormwater control facilities, streams, lakes, wetlands, or other water bodies during precipitation events. A constructed channel shall be shaped or graded to the required dimensions and established with a suitable lining as necessary to convey stormwater runoff without allowing channel erosion. The following guidance documents may be used for evaluation, planning, and design of constructed open watercourses to supplement the design criteria provided in the Manual.

1. NRCS Ohio Practice Standard 412, Grassed Waterways

2. NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7 - Grassed Waterways

3. Handbook 667, Stability Design of Grass-lined Open Channels

4. Federal Highway Administration, 1988, Design of Roadside Channels with Flexible Linings. Hydraulic Engineering Circular No. 15.

b. Channel Hydrology Requirements. Open watercourses shall be designed according to the same method used to design other onsite drainage facilities.

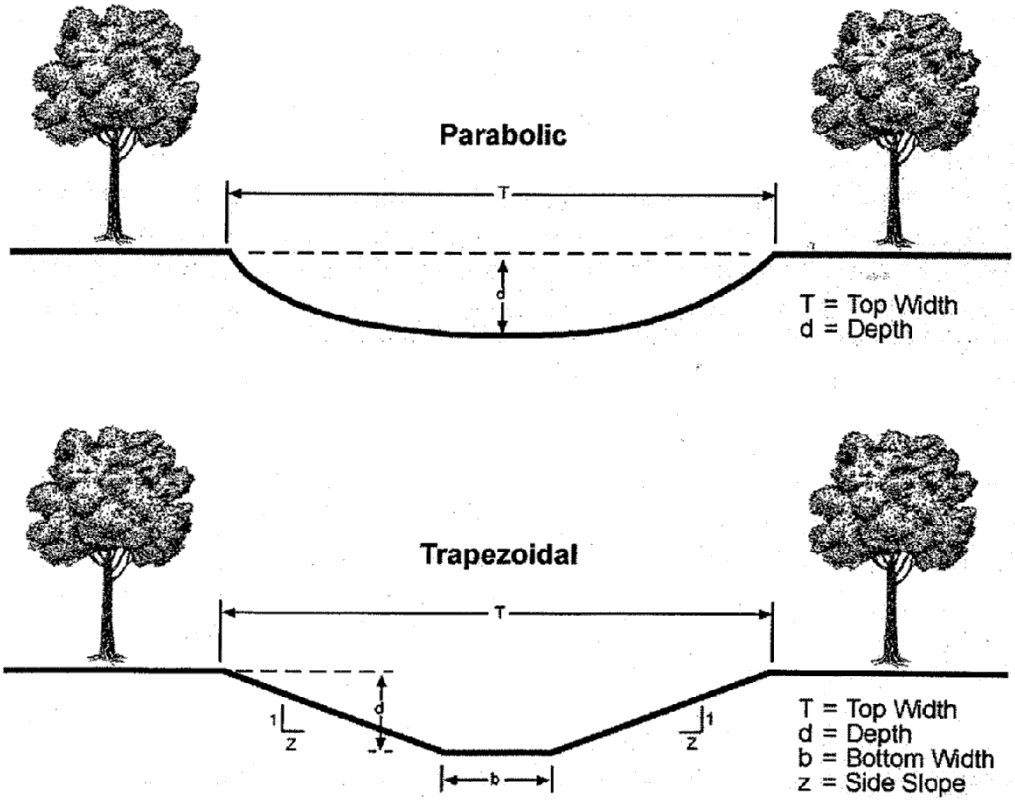
c. Channel Hydraulic Requirements.

1. Design Storm Frequency: Constructed open watercourses shall be designed to convey the 10-year design storm without causing erosion, sedimentation, or overbank flooding within and along the channel. Major Storm Physical Design Criteria (Section 3.3 of this Manual) shall be used if the channel will also serve as a flood routing channel for the 100-year design storm. Open watercourses may also be designed for stormwater quality control. ODOT's L&D Manual, Drainage Design aids may be used for sizing open conveyances (at various side

slopes). A ditch computation sheet shall be used to present open channel calculations.

2. Cross Section Shape: Parabolic and trapezoidal channel shapes (Figure 1) shall be used for open watercourses within development projects. Side slopes shall be 4(H) to 1(V) or milder, with a minimum 2-foot bottom width for trapezoidal channels, unless alternative dimensions are approved by the City due to specific project conditions. Channel cross sections shall be designed such that erosion and sediment deposition is minimized.

Figure 7-3. Parabolic and Trapezoidal Channel Shapes for Open Watercourses.



3. Design Velocity: An open channel is categorized by its lining. There are three main types of channel linings: vegetated, flexible, and rigid. A vegetative lining, such as grass with mulch and sod and lapped sod, is required where site constraints and flow velocity conditions allow. Flexible linings include rock channel protection and cellular soil retaining mats and are typically less expensive than a rigid lining. The use of flexible linings, however, may require the installation of a filter fabric or other means to protect the underlying soil, prevent washout, and prevent soil piping through the rock when using channel protection. Rigid linings, such as concrete, are generally not recommended and shall be avoided to the extent possible. Rigid linings may not be accepted within a public drainage easement unless prior approval is obtained from the City.

   Final design of constructed open channels should be consistent with velocity limitations for the selected channel lining. Maximum velocity values for selected vegetated and non-vegetated lining categories are presented in Table 7. The Manning's Equation shall be used to design an open channel that satisfies the maximum velocity criteria in the previous sections:

$$V = (1.49/n)\, R^{2/3}\, S^{1/2}$$

where:

V = average channel velocity (ft/s)
n = Manning's roughness coefficient
R = hydraulic radius (ft)
= A/P
A = cross-sectional area of the channel (ft^2)
P = wetted perimeter of the channel (ft)
S = slope of the energy grade line (ft/ft)

Recommended Manning's "n" values for open channels with vegetated and non-vegetated linings are provided in Table 7.

4. Critical Flow: Open channels shall be designed to flow under subcritical flow conditions at all times. A subcritical flow regime is characterized by a Froude Number less than 1.

$$F = V/(gD)^{0.5} < 1$$

where:

F = Froude Number
D = hydraulic depth (ft) = A/T
A = cross-sectional area of flow (ft^2)
T = top width of water surface (ft)
V = flow velocity (ft/sec)
g = acceleration due to gravity = 32.2 ($feet/sec^2$)

The Developer/Owner shall demonstrate that the calculated Froude Number is less than 1 over the anticipated range of flow conditions within the channel.

5. Rock Channel Protection Shear Stress Analysis: Type B, C or D rock channel protection shall be provided in accordance with Construction and Material Specifications City of Columbus (CMSC) Section 601.08. Type B, C or D rock channel protection shall only be placed outside of guardrails, barriers or other unobstructed areas provided outside of the traveled way for vehicles to stop safely or regain control. The actual shear stress (r_{ac}) must be less than or equal to the allowable sheer stress (r_a) listed in Table 9 for the rock channel protection type used. The actual shear stress shall be determined for the channel slope and the depth of flow during a 10-year design storm.

The following equation is valid for discharges less than 50 cfs and with slopes less than 10%:

$$r_{ac} = 62.4 * D * S$$

where:

D = depth of flow (feet)
S = channel slope (feet/feet)
r_{ac} = actual shear stress ($lbs/feet^2$)

Table 7-9. Manning's Roughness Coefficients for Vegetative and Artificial Channels

Channel Lining	Roughness Coefficient
Vegetated Lining:	
Seeded	0.03 (for velocity determination only without erosion control matting on all channels) 0.04 (for depth determination along roadside channels only) 0.06 (for depth determination, except along roadside channels)
Sod	0.04 (for velocity determination on all channels) 0.04 (for depth determination along roadside channels only) 0.06 (for depth determination, except along roadside channels)
Flexible Lining:	
Slope Erosion Protection	0.04
Erosion Control Matting	0.04
Grouted riprap	0.02
Rock channel protection (Typical for Type C/D) Small channels/ditches Large channels	 0.06 0.04
Rigid Lining:	
Concrete	0.015
Bituminous	0.015
Concrete block mat (tied)	0.021

Note: Increase roughness coefficient by 15% for Type B RCP.

Table 7-10. Allowable Sheer Stress for Rock Channel Protection

Type of Rock Channel Protection	r_{ac} (lbs/sq.ft)
B	6
C	4
D	2

In extreme site conditions, Type B or C rock channel protection shall be utilized for lining channels with steep grades (slopes 10%-25%) that carry flow from the end of a cut section down to the lowest elevation on the bottom of the channel. FHWA's HEC-15 procedures for steep gradient channels shall be used with a safety factor of 1.5. The Division of Sewerage and Drainage shall be consulted if rock channel protection is proposed in instances where the peak flow during the 10-year design storm is greater than or equal to 50 cfs.

6. Outlets: All constructed open watercourses shall have a structurally sound and stable outlet with adequate capacity to prevent ponding or flooding damage. Portions of open water courses affected by back water from Tier I or Tier II streams during dry weather flow conditions shall be provided with a stable outlet.

7. Natural Channel Design:
Natural channel design shall be used for open channel stormwater conveyance, in appropriate locations, with plan approval of the City Engineer. See ODNR Rainwater and Land Development Manual.

7.4.5 Detention Facilities

Areas designed for storage of stormwater by retention should be incorporated into the natural features of the general area, when possible. Cooperative planning and joint owner construction of detention and/or retention facilities and use of natural land contours is encouraged. The City encourages that detention or retention facilities be designed as multipurpose spaces such as open space, recreation and/or scenic areas. The City encourages use of fountains for aeration and reserves the right to require such an appurtenance as a condition to plan approval.

a. Ownership and maintenance. The owner and thus responsible party to provide maintenance and operation of a stormwater management facility (i.e., detention, retention basin, etc.), whether public or private, shall be determined prior to the acceptance by the Hilliard City Council of the relevant subdivision plat and the acceptance of the final engineering and construction plan. No lot sales will be permitted until this is done. Maintenance requirements and final design of all detention basins must be followed as specified in Section 4.10 below.

b. Location: All stormwater management facilities will be located in a reserve/open space as shown on the preliminary plat and final plat and will be owned by a homeowners association or an entity otherwise approved by the Hilliard City Council.

c. Types of facilities: In development and developing urban and suburban areas, several means for controlling stormwater runoff could be used. This usually involves storing runoff on or below the ground surface. The following types of storage facilities may be considered for detention and are subject to approval by the City Engineer and OEPA: rooftops, parking lots, underground tanks and surface basins or ponds (i.e., dry detention or wet retention) and man-made stormwater wetland systems.

7.4.5.1 Parking Lot Storage.

Parking lot storage is surface storage where shallow ponding is designed to flood specific graded areas of the parking lot. Controlled release features are incorporated into the surface drainage system of the parking lot. Parking lot storage is a convenient multi-use structural control method where impervious parking lots are planned. Design features include small ponding areas with controlled release by pipe-size and slope, and increased curb heights.

The major disadvantage is the inconvenience to users during the ponding function. This inconvenience can be minimized with proper design consideration. Clogging of the flow control

device and icy conditions during cold weather are maintenance problems. Parking lot design and construction grades are critical factors. This method is intended to control the runoff directly from the parking area, and is usually not appropriate for storing large runoff volumes.

a. Ponding areas in parking or traffic areas shall be designed for a maximum ponding depth of twelve (12) inches.

b. Flood routing or overflow must occur after the maximum ponding depth is reached.

7.4.5.2 Underground Storage

Tank storage utilizes an underground tank or chamber, either prefabricated or constructed in place, which has a special controlled release feature. This method is most applicable where land area is valuable, such as in industrial and commercial areas. Construction cost and operation costs make this method relatively expensive. Storage trenches, a variation on basic tank storage, are rock-filled underground storage tanks. The storage is provided within the void spaces between the rock material.

7.4.5.3 Retention Basins (Wet)

Wet Retention Basins (Ponds) are permanent ponds where functional stormwater management storage is provided above the normal water level with special features for controlled release. Historically, wet retention basins have proven extremely effective in abating increased runoff and channel erosion from urbanized areas. They are a major Soil Conservation land treatment practice.

Wet retention basins must be constructed outside any existing stream channels and outside the SCPZ.

Some potential problems encountered with wet retention basins are: site reservation (land requirements), permanent easements, complexity of design and construction, safety hazards, and maintenance problems. Because of large land requirements, and the necessity of maintaining a permanent pool of water, wet retention basins have a broader application for in-stream control where large watershed areas are involved compared to their use as on-site facilities for small urban areas. However, the recreational and aesthetic benefits of permanent wet retention ponds may justify certain on-site applications. Gradual slopes of 4:1 are required where a wet retention basin is to be constructed adjacent to an existing single-family development for that part along the existing single-family section, if a sufficient submerged bench cannot be constructed in the basin (see Section 4.5.3 b below).

a. The City encourages use of fountains for aeration and reserves the right to require such an appurtenance as a condition of plan approval.

b. The side slopes for a wet retention basin should be:

- A minimum five (5)-foot wide, two (2)-foot maximum depth submerged bench at waters edge around perimeter of the permanent storage pool;
- A maximum slope of 3:1 horizontal to vertical above the submerged bench.
- A maximum slope of 2:1 horizontal to vertical below the submerged bench;

c. Unless otherwise approved by the City Engineer, a minimum of twenty percent (20 %) of the pool area should be ten (10)-feet deep for water-quality benefit.

d. Rock Channel Protection Type D, may be required to be placed at the normal water elevation, around the entire perimeter of the basin, five feet wide, centered on the normal water elevation.

e. Wetland Perimeter A wetland shelf may be constructed around the perimeter of the basin. The wetland shelf should have a minimum width of 10 feet, and a maximum depth of 8 inches, and be planted in wetland plants (see Section 4.6.3 below).

f. Debris-control structures: Debris-control structures may be required and should be considered as an essential part of the design. The procedure recommended for use is Hydraulic Engineering Circular No. 9, available from the Superintendent of Documents, U.S. Government Printing Office, Washington D.C. For dams and levees over ten feet in height, refer to Section 1521.062, O.R.C.

g. Submerged Outlet/Inlet Structures:
   1. The City permits the use of submerged storm sewer outlets. Submerged Outlets may consist of a siphon pipe where such pipe is no smaller than twelve (12)-inches in diameter. For smaller outlet requirements, a bolted-on orifice plate may be used as the control feature, to be placed at the structure within the embankment. The siphon pipe material must be concrete. When using a submerged outlet, a stormwater retention basin must also include one or more additional stage outlet(s) with sufficient capacity to convey the 100-year storm discharge without overtopping the pond embankment.

   2. Inlet pipes that are equal to or larger in diameter than thirty-six (36)-inches must be submerged to at least the "springline" of the pipe (i.e., normal pool at a depth equal to the elevation at one-half the diameter of the pipe). When an inlet pipe is at least partially submerged at the pond, the conditions listed below must also be met.

   3. Submergence of inlet pipes is limited to the next upstream manhole or catch basin along the storm sewer system.

   4. All lengths of submerged storm sewer pipe shall include "o-ring" sealed gasket pipe joints.

   5. All lengths of the submerged sewer storm pipe shall have bedding and backfill material consistent with the City compacted embankment material specifications.

   6. Riser Outlet Structures: Catch basins and manholes used as the outlet structures may have a maximum elevation that is no more than 1.5 feet above the normal pool elevation and may include windows and grate-top openings. Where a catch basin is used as a second-stage outlet structure, the slope of the pond embankment must be graded to reduce the visibility of the structure.

Calculations must show that the capacity of the window(s) and/or grate top does not exceed the capacity of the "barrel" of the riser structure (calculated using the orifice equation).

7. Structure Requirements: All headwall and riser structures shall be in accordance with City of Columbus standard drawings. Final approval will be given by the city engineer or his designated official."

8. Bedding/Backfill Material: The bedding and backfill material for all storm pipe outlets shall consist of 100 percent cohesive embankment material or controlled-density fill. Where inlet storm pipes are submerged, bedding and backfill material for those pipes shall consist of 100 percent cohesive embankment material to the next structure upstream along the storm sewer system.

9. Anti-Seep Collars:
   - Anti-seep collars shall be used at all outlet storm pipe locations and shall be located (spaced) and sized in accordance with the criteria provided below. All anti-seep collars shall be constructed with material that provides a watertight connection to the pipe and is of a material that is compatible to the pipe. Anti-seep collars shall also be used along the submerged portion of any storm inlet pipes.

   - The anti-seep collars shall be located along the length of the outlet pipe within the saturation zone of the embankment (refer to Exhibit No. 1), at approximately equal spacing and at intervals not exceeding 25 feet. The saturation zone is considered to extend through the embankment from the elevation of the riser (normal pool) to the downstream embankment toe.

   - The anti-seep collars shall be designed to increase the length along the line of seepage (along the outlet pipe) by at least 15 percent. The proper design of the anti-seep collars may be achieved by either:

     - Selecting the number of collars and determining the minimum projection of the collar away from the outlet pipe: $V = 0.075 \times (L/N)$; or

     - Selecting the projection of the collar away from the outlet pipe and determining the minimum number of collars:

       $N = 0.075 \times (L/V)$

       Where:

       V = collar projection in feet
       N = number of collars
       L = length of outlet pipe within the saturation zone

10. Emergency Spillways: Emergency Spillways, when included in the designed pond outlet feature, must meet all of the following criteria:
    - They shall not operate (convey flow) for any design storm less than the 50-year event.

- They shall be reinforced with concrete or designed erosion control materials (geotextiles) consisting of 100 percent synthetic, non-biodegradable materials [the plans should include a specification for the intended geotextile, referencing the required physical properties or the specific material. Reference the State of Ohio, Department of Transportation Construction and Material Specifications Section 712.11, Type "E."

- They must include a designed "control section" that, when combined with the capacity of the principal spillway, will pass the major storm flood discharge up to the 100-year event [the plans must include a detail demonstrating the necessary dimensions of the control section, both width and breadth.

11. Miscellaneous: The following general criteria must be met:
    - Roof drains (downspouts) that outlet directly to the pond are not permitted.

    - All orifice plates shall conform to the requirements of City of Columbus Standard Drawing, No. AA-S145.

    - All inlet structures (e.g., pipe headwalls) must be recessed into the adjoining pond grading to diminish the amount the structure is visible.

7.4.5.4 Detention Basins (Dry)

a. Dry detention basins are surface storage areas created by constructing a typical excavated or embankment basin. There is no normal pool level and a specific controlled release feature included to control the rate of discharge.

b. Dry detention basins have been a widely used method of stormwater management in the past. However, current OEPA *guidelines* now *discourage* the use of dry detention due to problems with scour and re-suspension of deposited sediment. Dry detention basins are therefore discouraged and will require review and approval by the City Engineer.

c. The soil permeability and water storage potential are not as important with dry detention basins as with wet retention. They can be utilized in small developments because they can be designed and constructed as small structures or can be integrated into open, usable spaces for multi-purpose uses such as recreation and parks.

    1. The steepest side slopes for a dry detention basin should be 3:1 horizontal to vertical.

    2. Dry detention basin bottoms shall be sloped to drain, and such slopes shall be sufficient to mitigate against "flat spots" developing due to construction errors and soil conditions; or, bottoms shall be paved. The absolute minimum transverse slope for the bottoms of such facilities shall be one-half percent (0.50 %), with two percent (2.0 %) being the recommended

transverse slope. All transverse bottom slopes between one and one-half percent (1.5%) and one-half percent (0.5%) shall be lined with a minimum six (6)-inch thick air-entrained Class C concrete, reinforced with steel mesh to accommodate temperature stresses. Concrete shall have a synthetic linseed oil waterproofing treatment.

3. Dry detention basins must include a forebay and micropool each sized at 10% of the calculated WQv if the basin will be used for stormwater runoff qualitative control.

4. Invert ditches within dry detention basins, from the inlet to the outlet of all structures shall be paved if the slope is less than one-half percent 0.50 %. Such ditches shall be paved with a minimum six (6)-inch thick air-entrained Class C concrete, reinforced with steel mesh to accommodate temperature stresses. Concrete shall have a synthetic linseed oil waterproofing treatment. Minimum depth of paved invert ditch should be one (1)-foot.

5. Debris-control structures. Debris-control structures may be required and should be considered as an essential part of the design. The procedure recommended for use is Hydraulic Engineering Circular No. 9, available from the Superintendent of Documents, U.S. Government Printing Office, Washington D.C. For dams and levees over ten feet in height, refer to Section 1521.062, O.R.C.

7.4.6 Stormwater Treatment Wetlands

This technique involves design of a stormwater management facility that is intended to provide a water-quality benefit and incorporates a wetland system for water treatment. Use of this type of system must first be discussed with and reviewed by the City Engineer prior to design to determine acceptance by the City of Hilliard. Suggested design guidelines include:

a. Urban Runoff Quality Management: WEF Manual of Practice No. 23 and ASCE Manual and Report on Engineering Practice No. 87,. Water Environment Federation and American Society of Civil Engineers, 1998.

b. Design of Stormwater Wetland Systems: Guidelines for Creating Diverse and Effective Stormwater Wetland Systems, Thomas R. Schueler, Anascotia Restoration Team, Department of Environmental Programs, Metropolitan Washington Council of Governments, October 1992. E.

Proper wetlands design must create the proper conditions for wetland plants to thrive, as well as the proper hydrologic conditions to detain the water quality volume of runoff, and perhaps the flood control volume as well.

7.4.6.1 Design Consideration

a. Detention Volumes: Wetland extended detention ponds detain a volume equal to the water quality volume (WQv) found in Section 2.2.1.b.

The City may require additional detention volumes for peak discharge control (flood control). This additional storage volume shall use the top of the extended detention volume as a base elevation as shown in Figure 4.

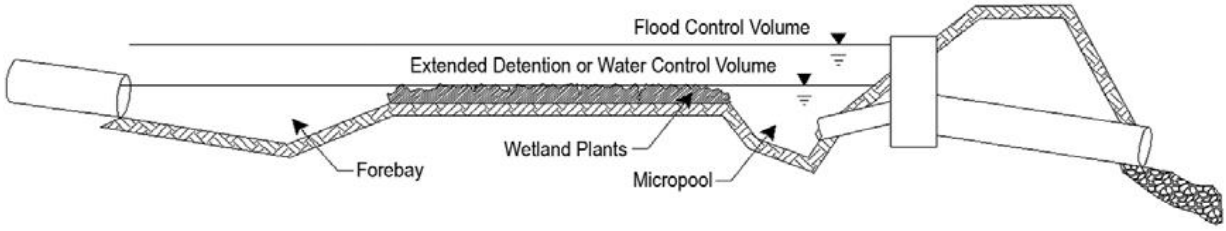


Figure 7-4. Wetland Stormwater Pond with Extended Detention and Flood Control Volumes (Rainwater and Land Development Manual, ODNR)

b. Outlet Design:
    1. Design the outlet structure (principal spillway) to draw down the extended detention volume over a 24-hour period. The outlet should empty less than 50% of this volume in the first 8-hours.

    2. Peak discharge control (flood control) required by local government can be incorporated into the spillway with additional control devices (e.g. orifices or weirs) above the extended detention outlet. This type of multiple outlet spillway incorporates outlet controls for each attenuation goal.

c. Permanent Wetland Pool Volume:
    1. The permanent pool volume is based on the designer's assessment of sufficient runoff and base flow to sustain a wetland pool. The designer should assess the change in storage volume over time based on water entering and leaving the wetland. This water budget should include water entering from precipitation, runoff, base flow, groundwater and any water to be pumped. Water leaving should include evaporation, expected plant transpiration, stormwater outflow, and seepage or percolation. Greater guidance on wetland creation and water budgets can be found in the Natural Resource Conservation Service Engineer Field Manual Chapter 13.

    2. A micropool, that is a deep area, greater than three (3)-feet, should be created at the outlet structure so that vegetation and sediment buildup do not interfere with outflow from the basin. Incorporating a deep pool at the inlet to the pond may be used to promote initial settling and dissipate concentrated inflow.

7.4.6.2 Establishing Wetland Vegetation

Six to eight species of wetland plants should be planted. Species that have worked well in constructed urban wetlands include: common three square, arrowhead, soft stem bulrush, wild rice, pickerelweed, sweetflag, smartweeds, spike rush, soft rush, and a number of other sedges.

Vegetation may be established one or a combination of the following methods: planting nursery stock (plants or rhizomes), mulching with soils from an existing wetland or allowing volunteer establishment. Using only volunteer establishment is discouraged since it often leads to mono-typical stands of invasive or undesirable species.

a. Planting Layout – Initial planting should cover at least thirty percent (30%) of the wetland area, concentrated in several portions of the pond and have densities of four to five plants/square yard. Planting clusters of single species will improve the quality and diversity plantings. Plants should be planned for their appropriate depth within the permanent wetland pool.

b. Grading or Disking the Basin – The basin substrate should be soft enough to permit relatively easy insertion of the plants into the soil. If the basin has been recently graded or excavated, the soil should be sufficiently soft. However, if the basin soil is compacted or hard subsoil is encountered, planting will be difficult. In these cases, it is recommended that the basin soil be disked or otherwise loosened before planting.

c. Flood and Drain Prior to Planting – If nursery stock will be used, it is recommended that the wetland area be flooded for a period of time (6-9 months, USEPA) prior to draining and planting.

d. Treatment of Plant Material – For successful establishment of wetland vegetation the nursery stock must be correctly handled prior to planting. For growing plants, this consists of keeping the roots moist at all times, and in keeping the plants out of direct sunlight as much as possible. Vegetation should be planted as soon as possible to avoid damage during on-site storage. Dormant plant material should be stored under conditions similar to those under which the material was stored at the nursery.

e. When planting container plants dig holes about one third larger then the container to allow root systems to have an un-compacted area in which to develop.

f. Mulching with Wetland Soils – If an area is mulched with soil from an existing wetland, plants should be allowed to germinate and grow for a period prior to fully inundating the wetland pool. Care should be taken to prevent the newly germinated plants to dry out.

7.4.6.3 Transition from Temporary Sediment Control Basin to Permanent Stormwater

Often permanent stormwater management ponds are used for sediment control during construction. In most cases, these facilities will need dewatering and sediment removal in order to insure that the pond has the appropriate volume for permanent stormwater design. This includes removal of temporary risers and skimmer structures used for sediment control and reseeding bare soil or establishing wetland vegetation in designated areas within the pond.

7.4.7 **Bioretention** (from Rainwater and Land Development Manual, ODNR)

Bioretention practices are stormwater basins that utilize a soil media, mulch and vegetation to treat runoff and improve water quality for small drainage areas. Bioretention BMPs provide effective treatment for many runoff quality problems including reduction of total suspended solids, heavy metals, organic compounds, bacteria and nutrients (phosphorous and nitrogen) by promoting settling, adsorption, microbial breakdown, and nutrient assimilation by plants.

7.4.7.1 Description

A bioretention area consists of a depression that allows shallow ponding of runoff and gradual percolation through a soil media, after which it either infiltrates through undisturbed soils or enters the storm sewer system through an underdrain system. Bioretention BMPs are sized for common storm events (the water quality volume) with runoff volumes from larger events typically designed to bypass the BMP.

A bioretention BMP is generally applicable for limited contributing drainage areas, generally less than 2 acres.

7.4.7.2 Design Considerations

a. Suitable soils: The bioretention BMP must be designed so that the runoff storage capacity will be drained within 24 hours either through infiltration into the existing soils under the facility. Facilities designed without an underdrain system shall have a qualified professional certify that in-situ soils are appropriate for infiltration. This certification shall include a description of the soil depth and horizons that correspond to the design elevations of the bioretention practice.

b. Setbacks to Prevent Water Damage: Appropriate setbacks from property lines, wells, septic systems, basements and building foundations shall be maintained to prevent damage to these systems or offsite areas.

c. Long Term Maintenance and Easements: Since bioretention combines plant materials with the temporary storage and filtering of stormwater, frequent regular maintenance is required. A legal and enforceable maintenance agreement shall be in place.

d. Surface Area: The surface area of the bioretention cell will generally be between five (5) and ten (10) percent of the contributing drainage area.

e. Construct Bioretention after Site Stabilization: Bioretention facilities shall be constructed after all other areas of the drainage area have been constructed and finally stabilized. Sediment-laden runoff from actively eroding sites will cause the premature failure of bioretention facilities and shall not be allowed to enter the bio-retention facility.

f. Detention: All bioretention practices shall be designed to treat the water quality volume by initially ponding that volume and allowing it to infiltrate through a soil medium within the practice. OEPA requires that runoff treated with a bioretention practice have a minimum drawdown time of 24 hours. While detention practices begin discharging soon after water begins to pond, each practice shall regulate the release of water such that no more than one-half of the water quality volume (see

Section 2.2.1.b.) is released in less than one-third of the drawdown period (24 hours).

g. Area Dimensions: The minimum recommended width of the landscaped ponded area shall be ten (10)-feet, with the length generally exceeding 2:1 (length:width). Pretreatment and conveyance areas may increase the overall size dedicated to the practice.

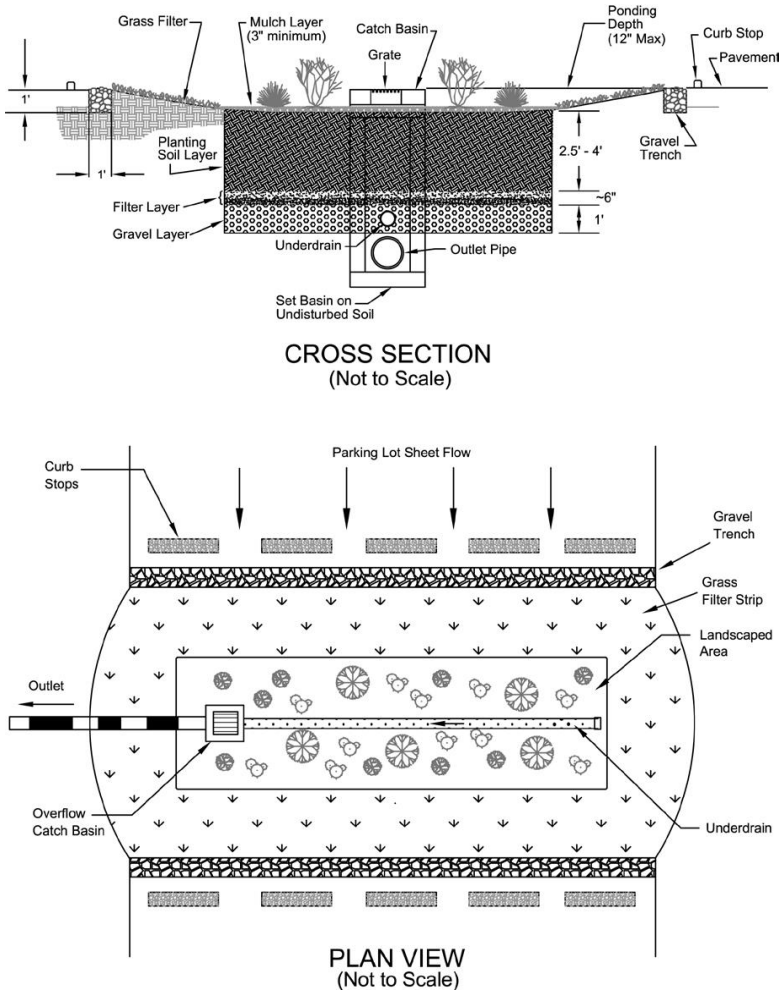


Figure 7-5. Bioretention Cell Layout
(Rainwater and Land Development Manual, ODNR)

7.4.7.3 General Components of Bioretention Practices

a. Pretreatment Area: Sediment or other pollutants before runoff enters the practice. A level stone trench at the edge of pavement, perpendicular to flow and a grassed area are typical options for pretreatment. Where flow is concentrated, a grassed swale, stabilized flow entrances, or forebay may be necessary.

b. Landscaped ponding area: The depth of ponding should generally be less than six (6)-inches, but may be designed for a depth to twelve (12)-inches maximum. The depth of ponding is controlled by the height of the overflow structure or berm containing runoff.

c. Mulch: A minimum of three (3)-inches of coarse shredded hardwood mulch is provided around plants and over the planting soil. Pine mulches and fine or chipped hardwood mulches may not be used since they tend to float and move. Grass may be planted instead of a mulch layer, especially in circumstances where maintenance is problematic.

d. Planting Soil: The planting soil filters and detains runoff, and much of the pollutant removal occurs in this zone. The planting soil or created soil mix shall be 2.0 feet in depth (settled). Soils and soil mixes must be certified by a qualified laboratory (1 test per 100 cu.yd.. of soil), and should consist of sand, organic amendment and topsoil per the following specifications:

e. Filter Layer: Designers may choose to use either geotextile or a combination of sand and pea gravel to prevent fines from the planting soil from migrating down through the underdrain or to the subsoil below the practice.

f. Gravel Layer and Underdrain system:
   1. A gravel bed eight (8) to twelve (12) inches consisting of # 57 washed stone shall be provided as a drainage medium and bedding material for underdrain pipes.

   2. Underdrains shall be a perforated pipe capable of withstanding the expected load above it and sized to exceed the drainage capacity of the planting soil layer.

g. Overflow and Routing: Bioretention facilities shall have a non-erodible means of discharging flow exceeding the capacity of the practice such as an overflow pipe or drop inlet set at the maximum ponding elevation.

h. Planting Materials: Species planted in bioretention practices should be adapted to the region, pollution tolerant, and able to survive the variable moisture conditions. Most plants should be facultative (found equally in wetland or upland conditions) though some species found in either environment may be acceptable. Native and non-invasive plants shall be used.

7.4.8 **Infiltration Trenches** (Rainwater and Land Development Manual, ODNR)

7.4.8.1 Description

An infiltration trench is a rock-filled trench that receives stormwater runoff, allowing it to infiltrate into the ground. These structures provide temporary underground storage in the form of a trench or other storage chamber filled with uniform graded stone.

Infiltration is an efficient post-construction stormwater practice, providing several benefits other control practices don't. Most notably, infiltration tends to reverse the hydrologic consequences of urban development by reducing peak discharge and increasing base flow to local streams. Unfortunately, infiltration trenches must be very carefully constructed to ensure they will continue to function, and they often have high long-term maintenance requirements.

7.4.8.2 Conditions Where Practice Applies

a. Smaller Sites: Infiltration trenches are generally not considered practical for sites larger than five (5)-acres. Used in small areas they offer flexibility in incorporating water quality treatment into a site's drainage system.

b. Soil Hydraulic Conductivity: Hydraulic conductivity describes the ability of water to move through a soil. Hydraulic conductivity should be at least fifty-two-hundredths (0.52) inches per hour but not more than two and four-tenths (2.4) inches per hour for infiltration trenches. Trenches should not be constructed on undisturbed soils that have been filled. On-site evaluation of soil parameters related to hydraulic conductivity and groundwater by a trained professional is recommended.

c. Industrial or Other Areas of Potential Ground Water Contamination – This practice should not be used in heavy industrial developments, areas with chemical storage, pesticide storage or fueling stations.

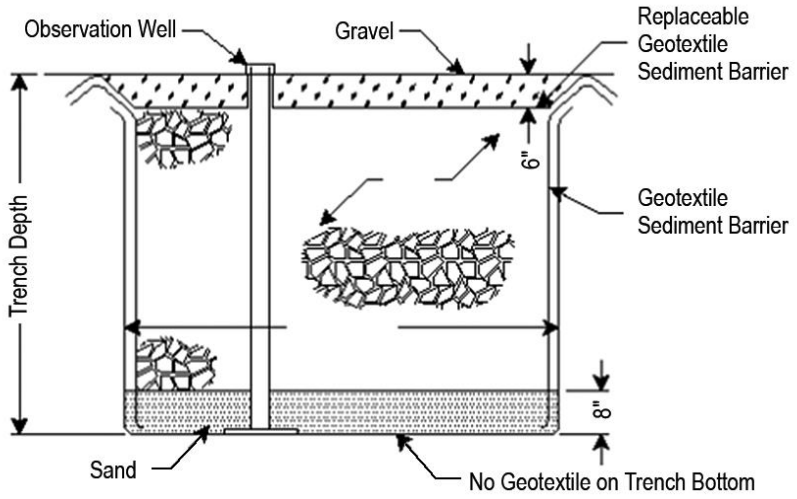


Figure 7-6. Typical Infiltration Trench Cross Section
(Rainwater and Land Development Manual, ODNR)

d. Stable Slope: Trenches should not be used in slip prone areas where they may cause slope instability.

e. Hydrologic Recharge: Infiltration practices help reduce runoff and may help support recharge of groundwater and baseflow to streams. This practice may be a particularly desirable option when the receiving stream is a cold water habitat.

7.4.8.3 Planning and Considerations

a. Sediment Clogging: The principle threat to infiltration trenches and a common reason for their failure is sediment clogging and sealing off of the permeable soil layer. An effective sediment trapping system, such as a vegetated swale, a buffer strip or a sediment settling pond, is an essential part of all infiltration trench designs.

b. Infiltration trenches may not be installed until disturbance from construction has ended and soils are stabilized.

c. Groundwater Protection: Precautions must be taken to guard against the facility introducing contaminants into water supply aquifers. Excessively permeable soils will not effectively stop pollutants and shall not be used for infiltration practices.

7.4.8.4 Design Criteria

a. Diversion: Storm water runoff shall be directed to the infiltration trench via dispersed sheet flow wherever possible. Where runoff is directed to the infiltration trench as concentrated flow (via a swale, storm sewer or other discrete conveyance), the infiltration trench must be designed "off-line" such that flows in excess of the Water Quality Volume (WQv) are diverted around the infiltration trench.

b. Soil Hydraulic Conductivity: Soil infiltration rates within the trench must be between 0.52 and 2.4 inches per hour. The soil shall have no greater than 20 percent clay content and less than 40 percent silt/clay content. A certified Soil Scientist or other trained professional shall be used to perform site-specific soil tests.

c. Pretreatment: The potential for failure of infiltration practices due to clogging by sediments is high. Thus, it is imperative that the facility design includes a durable, maintainable pretreatment system for removing sediment from stormwater before the trench.

d. Sizing the Pretreatment Facility: The size of the pretreatment facility is based on the infiltration rate of the soil in which the infiltration trench is built. For soils with infiltration rates of 2.0 inches per hour or less, the pretreatment facility shall be sized to contain 25% of the WQv. For infiltration rates greater than 2.0 inches per hour, the pretreatment facility shall be sized to contain 50% of the WQv.

e. Exit Velocity from Pretreatment Facility: The velocity of runoff as it exits from the pretreatment device must be non-erosive.

f. Drain Time Requirements: The practice is to be designed to infiltrate the Water Quality Volume (WQv) through the bottom floor of the structure in 24 to 48 hours. Drain times in excess of 72 hours should be avoided to prevent mosquito-breeding habitat from forming.

g. Dimensions: The dimensions of the storage reservoir (infiltration trench) are made by fitting the length, width and depth into a configuration, which satisfies drain time and storage volume requirements. Dimensional considerations include initial storage depth, area of trench bottom, and the trench length and width. The trench dimensions shall be sized by accepted engineering methods. See ODNR's Rainwater and Land Development Manual for dimensional and other design considerations.

h. Additional Information: designers considering the use of infiltration trenches should consult the ODNR Rainwater and Land Development Manual.

7.4.8.5 Infiltration Trench Components

a. Stone: The infiltration trench is filled with clean, washed aggregate. Stone with a diameter of between one (1) and three (3) inches should be used.

b. Geotextile: The sides and top of the trench must be lined with a non-woven geotextile to restrict the amount of sediment entering the structure.

c. Bottom Sand Filter: To promote continued infiltration, the bottom of the trench shall be covered with a clean layer of sand, approximately six (6)-inches deep.

d. Observation Well: An observation well, consisting of a perforated vertical 6-inch diameter PVC pipe with lockable cap shall be installed in the trench to monitor performance. The original depth of the well must be marked on the top of the well.

e. Overflow: Off-line infiltration trenches must have an overflow structure to handle discharge that exceeds the storage capacity of the trench.

f. Construction Sediment: Due to their sensitivity to sediment, infiltration trenches shall not receive runoff from disturbed areas of the site. It is advisable to construct the infiltration trench only after the contributing drainage area has been stabilized.

7.4.9 Grass Filter Strips (Rainwater and Land Development Manual, ODNR)

7.4.9.1 Description

Grass Filter Strips (GFS), also known as vegetated filter strips, treat the water quality of small sheet flows from developed areas. They are uniform strips of dense turf or meadow grasses with minimum slope, best suited to accept diffuse flows from roads and highways, roof downspouts, and very small parking lots. Although grass filter strips alone do not meet OEPA treatment standards for water quality, they are an ideal component of stream buffers or as pretreatment to a structural practice.

Natural meadow areas also may be used for grass filter strips. Grass filter strips are most often located in landscaping areas around building and parking lot perimeters, in greenbelts or along conservation easements, and median strips in parking lots and streets. The site's topography must allow shallow slopes and sheet flow runoff through the filter strip.

7.4.9.2 Conditions Where Practice Applies

a. Smaller Sites: Grass filter strips are not considered practical for sites larger than five (5)-acres. Used in small areas they offer flexibility in incorporating water quality treatment into a site's drainage system. The grass filter strips can be used as a supplemental practice or a pretreatment when combined with another structural treatment practice.

7.4.9.3 General Criteria for Grass Filter Strips

a. Grass Filter Strip design should be based on Rainwater and Land Development Manual (Ohio ODNR, etc).

b. Submittals/Plans: Runoff calculations, drainage area, slope of drainage & GFS, planting plan, soil information, slope length, schedule, other design components (spreader bar, etc).

c. The filter strip must abut the contributing drainage area.

d. The limiting design factor for grass filter strips is not the drainage area to the practice, but rather the length of flow leading to it. In general, the length of flow from impervious surfaces should not exceed 75 feet, and the length of flow from pervious surfaces should not exceed 150 feet.

e. The slope of grass filter strips should be one percent (1%) to five percent (5%).

f. Slope Length: A higher level of pollutant removal is achieved the longer the slope length (the distance water flows through a filter strip). Grass filter strips must have a minimum slope length of twenty-five (25)-feet, but should be designed to provide a slope length based on their slope within the ranges noted in the table below:

Table 7-11. Filter Strip Flow Length

Slope of Filter Strip	75% Particulate Trap Efficiency	90% Particulate Trap Efficiency
1%	25 ft	50 ft
2%	30 ft	120 ft
3%	40 ft	135 ft
4%	60 ft	170 ft
5%	75 ft	210 ft

g. Ground Water: Filter strips should be separated from ground water by at least two (2) to four (4) feet to prevent contamination and to assure that the filter strip does not remain wet between storms.

h. Soils: Filter strips will be less effective as the clay fraction of the soil increases, since this limits the infiltration of runoff associated with proper treatment. Filter strips are not suitable in very poor soils that cannot sustain a grass cover.

i. Assuring Sheet Flow: Level spreaders should be used if needed to assure an even flow onto the grass filter strip.

j. Establishing Vegetation: Dense vegetation is critical to effective filter strips. Poor stands of vegetation may even result in a grass filter strip eroding and becoming a source of pollution. A tool to select the appropriate vegetation based on site specific conditions is available on the internet from the USDA Natural Resource Conservation Service at: http://ironwood.itc.nrcs.usda.gov/Netdynamics/Vegspec/pages/HomeVegspec.htm.

Some common grasses suitable for use in Ohio include perennial ryegrass, tall fescue, red fescue and Kentucky bluegrass as well as Canada wildrye, Chinese silvergrass, orchardgrass, smooth brome, switchgrass, timothy and western wheatgrass. Salt-tolerant vegetation such as creeping bentgrass should be selected in areas that may be salted in the winter.

Seeding of the filter strip shall be completed no later than September 30th to assure establishment of sufficient vegetation by October 31st.

k. Pedestrian and Vehicular Traffic: Heavy use should be avoided to minimize soil compaction and maintain quality dense vegetation.

l. Maintenance: Only a minimum amount of maintenance should be necessary to ensure continued functioning of grass filter strips.

1. The most significant concern is gully formation from unexpected concentrated flows. If rills and gullies occur, they must be repaired and stabilized with seed or sod. Measures must be taken to eliminate the concentrated flow.

2. Filter strips shall be inspected annually to assure that the level spreader is not clogged and to remove built-up sediment.

3. Grass within the filter strip should be maintained as lawn. Grass height shall be approximately three (3) to four (4) inches. Vegetation must be kept healthy.

7.4.9.4 Specifications for Filter Strips

a. Filter strips shall be graded to prevent runoff from concentrating. Depressions, ridges and swales shall be graded out to achieve a uniform slope having a level grade across the slope.

b. To assure that runoff remains as sheet flow through the filter strip, a level spreader shall be used at the top of the slope. The rock or grass level spreader must be placed on a contour, and shall have a minimum width and depth of one (1) foot.

c. Soil compaction shall be minimized in the filter strip area. Work shall be performed only when the soil moisture is low.

d. A subsoiler, plow, or other implement shall be used to decrease soil compaction and allow maximum infiltration. Subsoiling shall be done when the soil moisture is low enough to allow the soil to crack or fracture.

e. Because a dense vegetation is critical for effective filter strips, only a dense stand of vegetation without rills or gullies shall be acceptable. If rills or gullies form, or if vegetative cover is not dense, a new seedbed shall be prepared and replanted.

f. The filter strip shall be seeded no later than September 30th to assure that vegetation establishes prior to the onset of winter weather.

7.4.10 Operation and Maintenance

7.4.10.1 Operation and Maintenance Plan

For the various storm water Best Management Practices (BMPs) described in this Manual, or any others that are proposed for a site, and for which the City has not accepted maintenance responsibility, a stand-alone Operation and Maintenance Plan document must be prepared to address the items listed below. A preferred template of this document is available from the City.

a. Designate the entity associated with providing the BMP(s) inspection and maintenance.

b. Indicate routine and non-routine maintenance tasks to be undertaken.

c. Indicate a schedule for inspection and maintenance tasks.

d. Provide proof of any necessary legally binding maintenance easements and agreements that are necessary to properly inspect and maintain the BMP(s).

e. Provide a map showing the location of the BMP(s) that are indicated on the approved Storm Water Pollution Prevention Plan (SWPPP) and any necessary access and maintenance easements.

f. Provide detailed BMP drawings and inspection and maintenance procedures.

g. Ensure that the collected pollutants resulting from BMP maintenance activities are disposed of in accordance with local, state and federal guidelines.

7.4.10.2 Inspection and Maintenance Agreement

a. An Inspection and Maintenance Agreement shall be made between the Owner and the City of Hilliard ensuring that the BMP(s) shall be properly inspected and maintained and shall be included within the Operation and Maintenance Plan.

b. Personnel identified within the Operation and Maintenance Plan shall inspect the BMP(s) to ensure proper functionality and determine if maintenance is necessary.

c. At a minimum, inspections are to be conducted annually, or more frequently as specified within the Operation and Maintenance Plan.

d. Written inspection reports summarizing the BMP(s) inspection observations and maintenance requirements are to be submitted to the City of Hilliard within thirty days after each inspection.

7.4.10.3 Maintenance

a. All BMPs are to be maintained according to the measures outlined within the Operation and Maintenance Plan.

b. Ensure that the collected pollutants resulting from BMP maintenance activities are disposed of in accordance with local, state and federal guidelines.

c. The Owner shall make necessary repairs within thirty days of their discovery as identified within the inspection reports or through a request from the City of Hilliard resulting from City conducted inspections.

d. Maintenance activities performed are to be documented in a written report and submitted to the City of Hilliard.

e. The Owner shall grant permission to the City of Hilliard to enter the property and inspect the BMP(s) whenever the City deems necessary. In an event of any default or failure by the Owner in properly maintaining the BMP(s) in accordance with the approved Operation and Maintenance Plan, or, in the event of an emergency as determined by the City of Hilliard, it is the sole discretion of the City, after providing reasonable notice to the Owner, to enter the property and take whatever steps necessary to correct deficiencies and to charge the cost of such repairs to the Owner. Nothing herein shall obligate the City to maintain the BMP(s).

7.5 REFERENCES

National Menu of Best Management Practices for Storm Water Phase II, United States Environmental Protection Agency, August 2002

VegSpec and PLANTS Database, United States Dept. of Agriculture, Natural Resource Conservation Service, http://plants.usda.gov

State Water Quality Management Plan, State of Ohio, Environmental Protection Agency, Division of Surface Water, 2006

Rainwater and Land Development, Ohio's Standards for Stormwater Management, Land Development and Urban Stream Protection, Ohio Department of Natural Resources, Division of Soil and Water Resources, Third Edition 2006

Appendix

Post-Construction Water Quality Best Management Practices Operation and Maintenance Plan Template

Chapter 8: Soil Erosion and Sedimentation Control

8.1 Design Requirements

8.1.1 The design requirements and supplemental specifications of the City of Hilliard and the City of Columbus, along with the current edition of the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual shall govern all soil erosion and sedimentation control designs for projects in the City of Hilliard.

8.1.2 No construction activity shall take place on a project until an Ohio EPA Notice-Of-Intent (NOI) permit is obtained for all project sites subject to the "Eligibility" requirements of either:

A. The OEPA General Permit for Storm Water Discharges Associated with Construction Activity, or
B. The OEPA General Permit for Storm Water Discharges Associated with Construction Activity located within the Big Darby Creek Watershed.

All temporary and post-construction best management practices (BMP's) shall meet the requirements of the applicable Ohio EPA General Permit above.

8.2 Standard Drawings

Soil erosion and sediment control details and/or standard drawings for projects in the City of Hilliard shall be in accordance with the requirements of the current edition of the ODNR Rainwater and Land Development Manual.

Chapter 9: Traffic Control Devices

9.1 Introduction

This chapter is to ensure uniformity in application of The City of Hilliard traffic engineering policies, guidelines, standards and practices related to traffic signals and beacons, roundabouts, signing, and pavement marking. It establishes the basic, minimum traffic control standards for all public streets in the City of Hilliard and all supplemental traffic engineering design, construction and operations. These standards should be implemented on all new capital improvement or development projects. The extent to which these standards are applied as part of normal city maintenance or rehabilitation projects is dependent on budget.

The location and design of all traffic control devices for all streets, highways, bikeways, and private roads open to public travel are governed by the most current version of the Ohio Department of Transportation (ODOT) *Ohio Manual of Uniform Traffic Control Devices* (OMUTCD) and supplemental City of Hilliard specifications.

The Engineer responsible for applying the concepts and practices assembled in this chapter is required to hold current registration as a Professional Engineer in the State of Ohio with experience in the design of traffic control devices. While this chapter provides technical guidance on design details, engineering knowledge, experience, and judgment must always be used to determine whether, and how, to apply the information included herein and in related design manuals to specific situations.

New or different design techniques presented herein or that are developed subsequent to the adoption of this Manual do not imply that existing traffic control device designs are unsafe, nor does it mandate the initiation of improvement projects. However, attempts should be made to upgrade traffic control devices to meet current standards in a reasonable manner and timeframe based on age of equipment, useful life, and history of maintenance activities associated with the device.

Maintenance of traffic control devices located within the public right-of-way shall be conducted by the City.

9.2 Traffic Signals and Beacons

Traffic signal technology changes at a rapid pace. The City reserves the right to change the traffic signal standards and specifications at any time without advance notice. The City reserves the right to experiment with new technologies on a case-by-case basis before officially adopting a new standard.

Traffic Signals. Chapter 4 of the OMUTCD governs the location and design on all traffic signals in the City. Existing vehicle and pedestrian traffic volumes shall be used in evaluating the need for a traffic signal (also known as a signal warrant analysis). In situations where a new roadway or intersection is being planned or the existing street network will be significantly altered, engineering judgment shall be used to develop appropriate opening day traffic volumes for use in a traffic signal needs study. A traffic signal shall not be installed on opening day of a development if a signal is not expected to meet minimum threshold volumes until a future year.

Traffic signal requirements that are unique to installations within the City of Hilliard are listed below.

1. Mast Arm Supports. All new traffic signals shall utilize mast arms and rigid-mounted vehicle signal heads. If existing span-wire traffic signals have been in place greater than 20 years and

development/redevelopment at the subject intersection is initiated, the span wire traffic signal should be converted to mast arm and updated in accordance with these standards at the time of development/redevelopment. All mast arms shall be in accordance with ODOT specifications except that they shall be smooth-sided and dark bronze or black (Old Hilliard only) in color in accordance with Hilliard specifications.

2. Vehicular Signal Heads. Vehicular signal heads shall utilize:
    a. High quality polycarbonate material
    b. Black exterior housing
    c. 12" lenses and compliant high flux LED lamps in all sections

    Backplates with yellow reflective tape provide supplemental warning of the presence of a traffic signal at night during power outages and improve visibility at sunrise and sunset of east/west mainline signal indications. Engineering judgment shall be used to determine the need for reflective backplates at Hilliard traffic signals. Factors that should be evaluated include traffic volumes, crash history, mainline east/west orientation, and presence of battery backup or an uninterruptible power supply at the intersection.
3. Vehicle Detection. Vehicle detection shall be provided for all lanes and phases utilized in the signal operation. The method of detection and specific product used is at the discretion of the City based on the signal location, inclusion in a closed loop signal system with established detection hardware, plans for future resurfacing, and unique site-specific challenges. Approved methods of vehicle detection include:
    a. In-pavement loop detection
    b. Radar detection
    c. Video detection
4. Signal Phasing. The minimum number of phases shall be used to safely move traffic with minimal delay. Protected left turn phases shall be used only if traffic volumes or site-specific safety considerations show that using a permissive left turn movement cannot safely accommodate turning traffic volumes. Because of excessive delay for vehicles and pedestrians, split phasing of side streets shall only be used when existing side streets are offset in a manner that the two sides cannot safely move concurrently. Split phasing of a traffic signal is not desired; therefore, a geometric improvement is preferred to correct deficient alignment if physically and financially feasible. If an existing traffic signal is being modified or a new traffic signal is being installed for a new development, split phasing shall not be used and new driveway or new streets shall be appropriately aligned at the intersection to allow side street phases to run concurrently.
5. Signal Timing. Signal timing and clearance intervals shall meet the requirements of the standards specified in the following documents. In case of conflicting specifications, the specification document hierarchy shall be in the order listed below.
    a. OMUTCD
    b. Institute of Transportation Engineer (ITE) *Traffic Control Devices Handbook*
    c. ITE *Manual of Traffic Signal Design*
6. Pedestrian Accommodations. All new traffic signals shall accommodate pedestrians through the use of pedestrian signal heads and pedestrian push buttons for detection unless pedestrians are specifically prohibited from using the intersection. Pedestrian accommodations include:
    a. Pedestrian signal heads shall be clamshell mounted and shall utilize filled LED symbolic displays with countdown timers. The exterior housing color shall be black and shall be consistent throughout the entire material. No louvered covers on the front side of the housing shall be used.
    b. Pedestrian pushbuttons shall be highly vandal resistant, pressure activated with a non-moving button, provide both a two-tone audible beep and a visible LED to notify users that the switch has been activated, and include a five-year warranty from manufacturer's defects. The exterior body color shall be black.

c. Supplemental pedestrian signal head or pedestrian pushbutton pedestals shall be smooth-sided. The exterior color of all surfaces, including anchor bolt covers, shall be dark bronze or black (in Old Hilliard only).
d. Pedestrian pushbuttons should be located near the end of each crosswalk in a manner that clearly designates the crosswalk for which each pushbutton corresponds in accordance with Section 4E.08 of the OMUTCD. Arrows shall be displayed on a crosswalk sign located above the pushbutton or through the use of a raised arrow integral to the pushbutton.
e. Accessible Pedestrian Signals (APS) should be considered on a case-by-case basis using the guidance provided in Section 4E.09 of the OMUTCD. An engineering study shall be conducted to determine the need for APS at a given intersection.

7. Signal Cabinet and Control Equipment. All traffic signal control equipment shall utilize the following:
    a. Ground-mounted control cabinet painted dark bronze (black in Old Hilliard only)
    b. Econolite controller (latest model)
    c. Generator inlet to power auxiliary generator during power outages
    d. Battery back-up shall be provided at the following intersections:
        i. Cemetery Road/Norwich Street
        ii. Cemetery Road/Leap Road
        iii. Cemetery Road/Lacon Road
        iv. Cemetery Road/Britton Parkway/Parkway Lane
        v. Cemetery Road/Lyman Drive
        vi. Cemetery Road/I-270 SB
        vii. Cemetery Road/I-270 NB
        viii. Cemetery Road/Trueman Blvd/Fishinger Blvd
        ix. Fishinger Blvd/Park Mill Run/Ridge Mill Dr
        x. Scioto Darby Road/Cosgray Road
        xi. Scioto Darby Road/Leppert Road
        xii. Davidson Road/Avery Road
        xiii. Davidson Road/Leap Road
8. Traffic Signal System Requirements. Signalized intersections may be grouped into a signal system based on engineering study and need for progression along a corridor. Delay to side streets shall be considered when evaluating new signal systems. All signal systems shall utilize the following:
    a. Econolite System Master
    b. Fiber-optic Interconnection
    c. Broadband Telecommunication System
9. Intersection Lighting at Traffic Signals. Unless the intersection is sufficiently illuminated using an independent street light system, 120-volt lighting (using LED luminaires in accordance with Hilliard street lighting specifications) shall be incorporated into the signal design using combination signal support(s) to achieve the required light level on the pavement at the intersection.
10. Spare Parts. Each new signal installation shall include two spare detection units (radar unit, loop amplifier, or camera).

School Zone Speed Limit Flashing Beacons. Flashing beacons supplement school zone signing and alert motorists when the 20 mph school speed limit is in effect. While flashing beacons are not required

per the OMUTCD, the City of Hilliard has established the following guidance to assist in determining when and where to install the flashing beacons:

- Schools with public street frontage on a street with a posted speed limit greater than 25 mph: 12" flashing yellow beacons supplement the 20 mph school zone signing located at the beginning of the school zone.
- Schools with public street frontage on a through street with a posted speed limit of 25 mph: 8" flashing yellow beacons supplement the 20 mph school zone signing located at the beginning of the school zone.
- Schools with public street frontage on a dead-end street, cul-de-sac, or private driveway: signs only (no flashing yellow beacons) located at the beginning of the school zone.
- Schools without public street frontage: no school zone is established on the public street; therefore, no signs or beacons reflecting a reduced speed limit are provided.

The above guidance applies to public and private K-12 schools located within the City of Hilliard with frontage on a public street that is under the jurisdiction of the City of Hilliard. Establishment of a school zone and installation of school zone speed limit flashing lights for schools that do not meet this criteria, shall be at the direction of the Law Director, Director of Public Safety, and Director of Public Service upon review of specific circumstances provided by the school administrator and review of applicable laws.

The school zone speed limit flashing beacon timing standard in the City of Hilliard is as follows:

- Morning Arrival: Activate flashing lights 30 minutes prior to the tardy bell; deactivate flashing lights at the tardy bell
- Afternoon Dismissal: Activate flashing lights at earliest dismissal; deactivate flashing lights 20 minutes after earliest dismissal
- Half Day Kindergarten: for schools that operate half day kindergarten, activate the flashing lights for 10 minutes after dismissal of morning kindergarten and 15 minutes prior to commencement of afternoon kindergarten; operation of the flashing lights mid-day for half day kindergarten may be eliminated if all kindergarten children are bused during mid-day hours or if the school district officials and city officials determine there is no need to operate the flashing lights over the lunch hour

The tardy bell and dismissal times for each school shall be in accordance with the Hilliard City School District (or private school) official posted school times unless otherwise modified in writing by a specific school.

In large school zones that serve more than one school, the start time of the flashing lights is based on the earliest school tardy bell and dismissal, and the end time of the flashing lights is based on the latest school tardy bell and dismissal time within the multi-school complex.

The above timing guidance is meant to establish a reasonable amount of time before and after school to allow school children to enter and leave the school grounds safely, taking into consideration normal school operating hours and *scheduled* late start or early dismissal times. The flashing lights are not intended to be used to designate special events, before and after school-age child care, extracurricular activities, unscheduled late starts or early dismissals, recess times, or unique schedule times that modify the official posted school times as established by the District.

If special circumstances result in the need to modify the above timing standard, the request shall be made and justification shall be provided in writing by the school administrator. The review and approval/disapproval of such requests shall be made by the City of Hilliard Division of Engineering.

Other Beacons. There are other warning or emergency beacons that provide guidance to motorists, pedestrians, or other road users of unique conditions or hazards within the public right-of-way. Some beacons have been studied extensively, are approved for use in the public right-of-way, and the location and design of the devices have been established in the OMUTCD. Other beacon uses are emerging as new technologies are developed. Design and installation of all beacons in the City of Hilliard shall follow the technical guidance established in the OMUTCD, or an engineering study shall be conducted to justify installation and establish design guidance of any devices not covered in the current edition of the OMUTCD or more recently released National Manual of Uniform Traffic Control Devices (MUTCD).

9.3 Roundabouts

The City of Hilliard recognizes that use of modern roundabouts to control intersections is growing exponentially in central Ohio and throughout the United States because of the benefits to intersection capacity, delay, safety, pedestrian mobility, power consumption, and community character over other methods of intersection control. While roundabouts may not be appropriate in all locations, the City of Hilliard supports and requires the evaluation of a roundabout installation in lieu of a traffic signal for all capital and development projects in the City. In some cases it may be appropriate to consider a roundabout at a location where a traffic signal may not be warranted. This may be at locations are where the desire is to:

- slow vehicle speeds;
- provide for a safer pedestrian crossing;
- change the roadway character; or
- provide for better intersection control for land uses that tend to experience variable traffic patterns, such as active parks and recreational areas.

The design of modern roundabouts shall be governed by the National Cooperative Highway Research Program (NCHRP) Report 672 *Roundabouts: An Informational Guide, Second Edition* or subsequent later editions. All consultants responsible for the design of roundabouts in the City of Hilliard, either as part of a public capital improvement project or a private development project, shall be required to show a high level of technical training and design experience in roundabout analysis, design, and operations.

The design of a roundabout is an iterative process that requires flexibility in order to achieve a good design. Therefore, the City of Hilliard does not establish strict design parameters for roundabout design but rather requires a series of performance checks that must be evaluated and adjustments in the design be made until a roundabout design is achieved that controls vehicle speed and balances the needs of all users. The following performance checks are required throughout the design process and shall be documented in a final report once all adjustments to the design have been made:

- Fastest path and natural path with appropriate speed control at entries and pedestrian crossings
- Design vehicle and CAD-generated turning templates for all movements
- Sight distance/visibility and CAD-generated line of sight exhibits (plan view and elevation view) for vehicle entries and pedestrian crossings

If an existing signalized intersection is being studied for an upgrade, modification or capacity improvement, the installation of a roundabout shall be evaluated as an alternative in lieu of a traffic signal unless the signalized intersection is located within a closed loop signal system.

If a new development proposes a medium to high volume access point to a public street that is listed on the City's Thoroughfare Plan and future traffic volumes indicate that a traffic signal may be justified based on an engineering study, a roundabout shall be evaluated as an alternative in lieu of a traffic signal or stop-controlled intersection. Improved pedestrian crossing and corridor traffic calming shall be considered in the roundabout evaluation. A roundabout is considered preferred for all new intersections over signalized intersections provided that the roundabout is expected to function at an equal or better level of service (for all modes of traffic) than the traffic signal.

In situations where a new roadway or intersection is being planned or changes to the existing street network will be significantly altered, engineering judgment shall be used in developing appropriate opening day traffic volumes and long range traffic volumes to use in the intersection evaluation study. If a roundabout is selected as the preferred alternative by the City, engineering judgment shall be used to determine the appropriate design year for a roundabout improvement and consideration should be made to planning for a tiered construction of the roundabout to avoid "over building" in short term. Determination of the appropriate design year for roundabout improvements is subject to the approval of the City Engineer.

9.4 Signing and Pavement Marking

Chapter 2 and 3 of the OMUTCD govern the location and design on all signing and pavement marking, respectively, in the City of Hilliard. Chapter 7 of the OMUTCD governs the signing and pavement marking for public streets surrounding schools in the City of Hilliard. Chapter 9 of the OMUTCD and the AASHTO Bike Guide governs the location and design of all signing and pavement marking for on-street and off-street bicycle facilities in the City of Hilliard.

Signing requirements that are unique to installations within the City of Hilliard are summarized below. Details are provided in Hilliard Standard Construction Drawing TC-1, TC-2, and TC-3.

Street Name Signs. All street name signs shall use shall use white retroreflective sheeting made with prisms with a blue electrocut film to create a blue sign with white lettering. Street name legends, prefixes, and suffixes shall utilize a Clearview Font Type 2-W and shall be centered horizontally and vertically on the sign face. The number of signs per intersection, the height of the sign blade, maximum blade length, and lettering height is dependent on the type of intersection.

Street Name Sign Supports and Anchors. The type of street name sign support and anchor used is dependent on the type of intersection and location.

Signalized intersections. The street name signs shall be rigidly mounted on the appropriate signal support (strain pole or mast arm).

Unsignalized intersections. In all locations *except* the Conservation District street name signs shall be erected on 2-inch square galvanized posts with die-cut knock-outs (painted black in Old Hilliard only) using a single breakaway anchor and pyramid rain caps. When one or more sign erected on a 2-inch square post exceeds 60 inches, the anchor shall be modified with flanges to provide additional stability and reduce torque from wind loading. The length of post, length of anchor, and required overlap is dependent on the type of intersection.

Within the Conservation District, street name signs at unsignalized intersections shall be erected on 6-inch square rough sawed cedar posts with a ½-inch chamfered top. The post shall be anchored with a square steel tube, embedded into the ground a minimum of 42 inches, and concrete encased. Two lag bolts shall be provided on the street side to allow for breakaway function. The length of post is dependent on the type of intersection; all details regarding the length of post and anchor, limits of concrete encasement, and other details are provided in Hilliard Standard Construction Drawing TC-3.

Regulatory, Warning, and Guide Signs. All signs within the public right-of-way shall be retroreflective.

For all basic sign installations, the sign sheeting material shall comply with ASTM D456 Type IV (3M High Intensity Prismatic, Avery Dennison High Intensity Prismatic T-6500, or approved equal).

High priority signs shall utilize a sign sheeting material that complies with ASTM D4956 Type VIII (3M Diamond Grade LDP 3970, Avery Dennison MVP Prismatic T-7500, or approved equal. In the City of Hilliard, the following sign types shall be considered high priority: School Zone Speed Limit signs, School Crossing/Warning signs & placards, Pedestrian and Bicycle Warning signs, STOP signs along or intersecting arterial/collector streets, and YIELD signs at roundabouts. The City may designate other types of signs as high priority and utilize higher reflective sheeting based on site specific conditions.

Two-inch wide reflective sheeting strips shall be used on all sign posts located in raised medians to increase visibility; reflective sheeting strips may be used at other locations as determined by the City.

Signs should be located in a manner that improves visibility to motorists. Signs, particularly high priority signs, shall not be installed directly behind light poles or trees.

Sign Supports and Anchors. All regulatory, warning, and guide signs located within the public right-of-way, *except* within the Conservation District, shall be erected on 2-inch square galvanized posts with die-cut knock-outs (painted black in Old Hilliard only) using a single breakaway anchor and pyramid rain caps. For all signs installed in concrete or paver islands, a six-inch PVC pipe box out shall be provided for the post anchor. The PVC box out shall be installed prior to pouring concrete or placing pavers. After the sign post anchor is installed, granular material shall be installed between the post anchor and the PVC box out.

Within the Conservation District, regulatory, warning, and guide signs shall be erected on 4-inch square rough sawed cedar posts with a ½-inch chamfered top. The post shall be anchored with a square steel tube, embedded into the ground a minimum of 42 inches, and concrete encased. Two lag bolts shall be provided on the street side to allow for breakaway function. The length of post is dependent on the height of sign(s) being installed; all details regarding the length of post and anchor, limits of concrete encasement, and other details are provided in Hilliard Standard Construction Drawing TC-3.

Chapter 10: Lighting

10.1 Introduction

Lighting of public streets and other public spaces represents a large portion of a city's energy budget, it affects a community's sense of safety and security, and it also has an impact on the degree that a city provides an inviting and aesthetic environment for business and quality residential growth. Therefore, it is important to strike a balance between fiscal responsibility, environmental stewardship, safety, and aesthetics. Overall, it is important to understand that many factors contribute to a good lighting design, and too much lighting can be just as bad as too little lighting.

Major advantages of street lighting includes: prevention of accidents and increase in safety. Studies have shown that darkness results in a large number of crashes and fatalities, especially those involving pedestrians. Therefore, areas that have higher vehicle traffic volumes, higher vehicle speeds, higher pedestrian volumes, or unique geometric considerations such as horizontal or vertical curves would benefit from street lighting. Disadvantages to street lighting include light pollution, glare, and increased energy consumption. The advantages and disadvantages of street lighting should be balanced based on the type, characteristics, and use of the street; treatments should be utilized to protect vulnerable road users; and new technologies should be used where feasible to minimize the negative aspects of lighting.

The City of Hilliard is committed to incorporating advanced lighting technologies, such as the use of light emitting diode (LED) lights, in the city's publicly owned and maintained street lighting systems to reduce the City's power consumption. These advanced technologies are more energy-efficient and longer-lasting than the street lighting technology used in the past in the City, specifically high-pressure sodium (also known as high intensity discharge or HID). For several decades the international lighting community has discussed the need to revise photometric practice to recognize that the *color* of light has a significant effect on vision, particularly peripheral vision, in outdoor, low-light conditions. The results of studies have shown that a high pressure sodium (orange-pink light) streetlight can be replaced with a broad spectrum (white) streetlight that emits less light for equal or better visibility.

The City of Hilliard is also committed to reducing light pollution by focusing lighting downward toward the streets and pedestrian areas through the use of shielded or cut-off fixtures for all new lighting installations. New installations should avoid glare, eliminate light disbursement above 90 degrees, and minimize light trespass beyond the areas intended to be lit.

The transition to the use of LEDs or other future energy-efficient sources for the city's street lights will be immediate for all new street light installation. For retrofit of existing street lights, the conversion will occur as part of normal maintenance activities or as funds become available to do a wholescale retrofit of a corridor. This change to using LED technology does not imply that the old HID lighting is unsafe or noncompliant nor does this change require retrofit within a certain period of time.

This chapter establishes the general criteria and minimum standards for lighting in the following situations:

- Continuous lighting of public streets for various street types and Districts
- Spot lighting of public intersections, pedestrian crossings, or other unique circumstances
- Retrofitting of existing public street lights
- Lighting of private commercial or industrial properties

10.2 City of Hilliard Public Street Lighting Policy

New Street Construction or Reconstruction. The City of Hilliard will evaluate street lighting for all new street construction or reconstruction projects along the Thoroughfare Plan street system. For streets that will incorporate curb & gutter, installation of a continuous street lighting system is recommended. For streets that will *not* incorporate curb & gutter, spot lighting of intersections, pedestrian crossings, or other unique circumstances is recommended, at a minimum. In these cases, the City of Hilliard is responsible for the design, installation, and maintenance of the street lighting system.

Existing Streets and Intersections. For existing streets or intersections that are not part of a larger street reconstruction project, lighting of intersections may be considered on a case-by-case basis. Lighting of isolated locations is dependent on location of a power source and presence of existing private utility poles. The City may request the installation of a street light on a private utility pole by the private electric utility provider in locations where no continuous light system exists or is planned in the near future. In this case, the private electric utility provider would be responsible for the design, installation, and maintenance of the lighting, and the City is billed for the electric usage.

New Pedestrian Crossings. Street lighting should be installed at all new pedestrian crossing locations. To properly light a pedestrian crossing, the lighting should be located at or before the crosswalk to avoid backlighting of pedestrians.

New Intersections at Development Entrances. As development occurs along the Thoroughfare Plan street system, street lights should be installed at the intersection of the neighborhood collector street and the Thoroughfare Plan street system if no continuous street lighting system exists at the time of development. Installation of street lighting may be considered at commercial driveways. Lighting of new intersections, whether a public street or a private commercial driveway, is the responsibility of the developer to design and install. Maintenance of these lights is dependent on location: street lights in public right-of-way on city poles are the responsibility of the City; street lights on private property are the responsibility of the private property owner/developer; street lights on private utility poles are the responsibility of the private utility.

Residential Subdivisions. Street lighting should be installed along all local residential streets within a new residential subdivision, excluding the Conservation District. In subdivisions outside the Conservation District, lighting should be provided in manner that reasonably lights the streets and pedestrian ways taking into consideration location of power sources, lot lines, and street configuration. Within the Conservation District, lighting will be at intersections and pedestrian crossings only. Design and installation of lighting within a new residential subdivision is the responsibility of the Developer. Maintenance of the lighting in these cases is the responsibility of the City after acceptance and the one-year warranty period expires. Light(s) and/or pole(s) that are damaged as part of construction activities are the sole responsibility of the Developer to repair and/or replace.

Commercial or Mixed Use Streets. On public streets serving commercial development or mixed use development that are not listed on the City's Thoroughfare Plan, a continuous street lighting should be installed; residential scale lighting may be used in this case. If the commercial or mixed use street is constructed as part of a new development, the design and installation of the lighting system is the responsibility of the Developer. Maintenance of the lighting in these cases

is the responsibility of the City after acceptance and the one-year warranty period expires. Light(s) and/or pole(s) that are damaged as part of construction activities are the sole responsibility of the Developer to repair and/or replace. In existing commercial or mixed use development, such as along streets in the Old Hilliard District, a continuous street lighting system should be designed and installed by the City as part of a street reconstruction and/or streetscape project; maintenance of the street lighting system is by the City.

10.3 General Lighting Design, Material, and Construction Requirements

The following requirements apply to all lighting installed throughout the City of Hilliard and shall be incorporated into all lighting plans as Lighting General Notes.

Design Requirements. The design and layout for street lights, underground wiring and other pertinent equipment to be used shall be in conformance with guidelines issued by the Illuminating Engineering Society of North America (IESNA), stamped by a registered professional engineer and approved by the City Engineer.

Construction & Material Specifications. All electric work performed under these specifications shall be in accordance with the latest edition of the National Electric Code (NEC), which is published by the National Fire Protection Association and is a United States standard for the safe installation of electrical wiring and equipment, and all state or local codes that may apply, including but not limited to Columbus Item 1000 and ODOT Item 625.

Coordination with Electric Utility. Metering of electricity for street lighting is not required. Street lighting designs shall be coordinated with the electrical energy supplier by the design engineer; the type of lighting, including the use of all advanced lighting technologies, shall be clearly defined in order to estimate energy use. The number and format of record plans to be submitted shall be determined by the supplier of electric energy. All service enclosures along public streets shall be pad-mounted and screened; aboveground pole or post-mounted assemblies are not permitted.

Conduit Location. Lighting conduit parallel to the street shall be located per Hilliard Standard Drawing SL-6. All other lighting conduit shall be located two (2) feet minimum off side and rear lot lines in a five (5) foot minimum easement. Minimum depth for conduit is two (2) feet. Electrical warning tape (red) shall be provided one (1) foot over top of street light cable and conduit.

Construction Submittal Requirements. The Contractor/Owner/Developer shall submit manufacturer's specification sheets to the City Engineer for approval prior to installation. Manufacturer's specification sheets are required for the following items:

- Luminaire
- Lamps
- Pole
- Photocell
- Service Enclosure
- Pull box
- Conduit
- Cable
- Hand holes
- Controls

Spare Materials. For each new project where street light poles are installed in public right-of-way, additional poles(s), luminaire(s), and all incidental hardware, shall be provided to the City of Hilliard Service Department for maintenance purposes. The required number of spares is based on a ratio of 1 spare for each 10 new poles with a minimum of one complete assembly (pole, luminaire, and all incidental hardware) for all systems of four (4) or more poles. If fewer than 4 poles are installed, this requirement is waived. The following are the number of additional poles, luminaires, and incidental hardware that are required:

Poles Installed	Additional Poles, Luminaires, & Hardware to be delivered to City
0 – 3	0
4 – 10	1
11 - 20	2
21 - 30	3
31 - 40	4
more than 40	5

These additional "material only" items shall be clearly defined as a separate line item in the general summary or quantities. All spare equipment shall be delivered to the City of Hilliard Service Department prior to acceptance of the project. A signed itemized receipt showing the items and quantities delivered to the City shall be provided by the contractor to the inspector prior to acceptance and/or payment of materials.

Permits and/or Easements. The Contractor/Owner/Developer shall obtain all permits required by the Public Authority having jurisdiction, including a Hilliard right-of-way permit. All easements required for construction shall be secured and submitted to the City of Hilliard for recording prior to commencement of work; no work which requires an easement shall proceed until this is complete.

Construction Inspection. The City Engineer or his authorized representative shall perform inspection of the work. The City Engineer will require at least forty-eight (48) hours' notice before any work takes place. No underground cable shall be backfilled until inspected. Failure to request the necessary inspection may result in the rejection of the work and the project.

Testing. The Contractor/Owner/Developer shall conduct Electrical Tests per COLS item 1000.18 and ODOT item 625.19.

Post-Construction Submittals. The Contractor/Owner/Developer shall provide one paper copy and one electronic (PDF) copy of the following items:

- Final "as-built" drawings for the lighting system
- An Operations & Maintenance (O&M) Manual (paper copy in a 3-ring binder) for all electrical items provided in the Project

Acceptance. Following installation of the lighting system, the Contractor/Owner/Developer shall request final inspection by the City of Hilliard Operations Division. Within one week, the final inspection will be conducted, and a final punch list will be issued. Upon completion of all punch list items, the City, or their representative, will officially accept the lighting system in writing. This date establishes the beginning of the warranty period.

Warranty. The warranty period for all lighting systems, materials, and/or other electric components is one (1) year unless otherwise extended in the plans. Any poles, luminaires or

other equipment that are damaged as part of construction activities are the sole responsibility of the Developer to repair and/or replace, independent of the status of the warranty period.

10.4 Lighting Design Criteria

The desired level and uniformity of lighting along a street is dependent on roadway characteristics (type of street, ADT) and the pedestrian environment. The table below establishes the City of Hilliard lighting design criteria for the various types of street classification and pedestrian activity classification. The purpose of using this table in lieu of a "one size fits all" approach to lighting design is to allow for flexibility and the provide appropriate light levels for different types of situations.

Street Classification	Pedestrian Activity Classification	Avg. Lumin. (fc)	Avg:Min	Max:Min	Crosswalk Min (fc)
A	High/Medium	1.0	3:1	6:1	0.5
	Low	0.6	3:1	6:1	0.3
B	High/Medium	0.8	3:1	6:1	0.5
	Low	0.4	4:1	8:1	0.3
C	High/Medium	0.5	6:1	10:1	0.3
	Low	0.3	6:1	10:1	n/a

The *street classifications* are described as follows:

Type A: Most Thoroughfare Plan streets (primarily major & minor arterials); Design ADT > 7,500 veh/day

Type B: Some Thoroughfare Plan streets (primarily network collectors) and local streets within Mixed-Use & Commercial/Industrial Districts; Design ADT between 2,000 to 16,000 veh/day

Type C: Local Residential streets; Design ADT < 2,000 veh/day

The *pedestrian activity classifications* are described as follows:

High/Medium: areas where a moderate to high level of pedestrians are expected to be on the sidewalks or crossing the streets during dark hours. Example land use types include mixed-use areas, neighborhood or downtown retail areas, apartments, schools, restaurants, and some recreational/park uses.

Low: areas where a low level of pedestrians are expected to be on the sidewalks or crossing the streets during dark hours. Example land use types include low density single family, office-only, and industrial uses.

10.5 Thoroughfare Plan Street Lighting

This section pertains to all public streets listed on the City of Hilliard Thoroughfare Plan, excluding those streets that are located within the Old Hilliard District or the Conservation District.

The importance of street lighting on safety, particularly at pedestrian crossings and at curves in the street, is well documented in studies nationwide. Because Thoroughfare Plan streets carry a larger volume of traffic at higher speeds, more stringent design criteria are established for these streets.

All new Thoroughfare Plan street lighting installations in the City of Hilliard shall be designed by a registered professional engineer with street lighting experience using roadway lighting guidelines issued by the Illuminating Engineering Society of North America (IESNA). IESNA is considered the nation's technical authority on illumination. IESNA's RP-8 provides the design basis for lighting roadways, adjacent bikeways, and pedestrian ways. RP-8 provides for flexibility in design guidance based on roadway characteristics and the pedestrian environment.

Luminaire. Luminaire shall have a dark bronze cut-off type housing with LED lights per Hilliard Standard Drawing SL-4.

Pole . Poles are aluminum, smooth, round, and tapered with a powder coated dark bronze finish. The typical nominal height is 31', including the transformer base. See Hilliard Standard Drawing SL-3.

Service Enclosure. Service enclosure shall be a 30"H x 18"W x 15" D stainless steel watertight enclosure with a dark bronze powder coated finish. See Hilliard Standard Drawing SL-5.

Pole Placement. Poles should be staggered on opposite sides of the street and shall be placed a minimum of 2' behind the back of curb on straight street sections. On non-linear sections of street, such as at curves, at intersection radii, and at roundabouts, poles shall be placed a minimum of 4' behind the back of curb. On an uncurbed street, poles should be offset an appropriate distance from the pavement edge to avoid the striking by an errant vehicle, based on the design speed of the street and the location of a roadside ditch. Poles should be offset from street trees a sufficient distance to avoid tree foliage from interfering with normal light distribution. The exact minimum spacing is dependent on the mature height and spread of the trees along the street; therefore, the landscape architect and lighting design engineer should consult early in the design process to select an appropriate tree species to be compatible with the lighting and roadside environment.

Intersection or Spot Lighting. At signalized intersection locations, street lighting may be installed on the mast arm signal supports in lieu of separate light poles. At unsignalized intersections or pedestrian crossing locations, spot lighting may be provided in a manner to appropriately light the location in accordance with the criteria listed above. To properly light a crosswalk, the lighting should be located before or at the crosswalk to illuminate the pedestrians in the crosswalk and avoid backlighting.

Hilliard Standard Construction Drawing references. Thoroughfare plan street light material specifications shall be as follows:

1. Pole Base – per Hilliard Standard Drawing SL-1 & SL-2

2. Pole – per Hilliard Standard Drawing SL-3
3. Luminaire Assembly – per Hilliard Standard Drawing SL-4
4. Service Enclosure – per Hilliard Standard Drawing SL-5
4. Conduit/Trench – per Hilliard Standard Drawing SL-6
5. Conductors – per Hilliard Standard Drawing SL-17

10.6 Local Street Lighting – Residential Subdivision (except for Conservation District)

This section pertains to the lighting of local public streets within residential subdivisions, excluding those local streets that are located within the Old Hilliard District or the Conservation District.

The City of Hilliard requires the lighting of local residential streets; however, the design criteria and placement of poles is more flexible due to the lower volume and speed of vehicular traffic.

Luminaire. Luminaire shall have a cast aluminum housing with a black satin finish with LED lights. See Hilliard Standard Drawing SL-8.

Pole.
Poles are tapered, combination fluted and smooth with an octagonal base, made of cast aluminum with a black satin ground finish. The typical nominal height is 12'-6", including the base. See Hilliard Standard Drawing SL-7 and SL-8.

Service Enclosure. Service enclosure shall be a watertight, 1 phase 3 wire 2 breaker box mounted on a pressure treated 4"x6" wood post. See Hilliard Standard Drawing SL-9.

Pole Placement. Poles should be located on both sides of the street, placed 2' minimum behind the back of curb, and a minimum of 5' from driveway aprons. Poles should be offset from street trees a sufficient distance to avoid tree foliage from interfering with normal light distribution.

Hilliard Standard Construction Drawing references. Local residential street light material specifications shall be as follows:

1. Pole Base – per Hilliard Standard Drawing SL-7
2. Pole and Luminaire Assembly – per Hilliard Standard Drawing SL-8
3. Service Enclosure – per Hilliard Standard Drawing SL-9
4. Conductors – per Hilliard Standard Drawing SL-17
5. Pull Box – per Hilliard Standard Drawing SL-11

10.7 Local Street Lighting – Commercial, Industrial, or Mixed-Use Development

This section pertains to the lighting of local public streets within commercial, industrial, or mixed-use developments, excluding those local streets that are located within the Old Hilliard District or the Conservation District.

Mixed use districts provide a variety of land uses that encourage walking and bicycling for short trips. While vehicle speeds and volumes are likely much lower than those on Thoroughfare Plan streets, a

higher volume of pedestrian activity is anticipated. Therefore, it is important that a street lighting system be designed that provides appropriate levels of lighting yet utilizing poles that are of a smaller scale.

Luminaire. Luminaire shall have a cast aluminum housing with a black satin finish with LED lights. See Hilliard Standard Drawing SL-8.

Pole. Poles are tapered, combination fluted and smooth with an octagonal base, made of cast aluminum with a black satin ground finish. The typical nominal height is 12'-6", including the base. See Hilliard Standard Drawing SL-8.

Service Enclosure. Service enclosure shall be a 30"H x 18"W x 15" D stainless steel watertight enclosure with a dark bronze powder coated finish. See Hilliard Standard Drawing SL-10.

Pole Placement. Poles should be staggered on opposite sides of the street and shall be placed a minimum of 2' behind the back of . At intersection radii, poles shall be placed a minimum of 4' behind the back of curb. On an uncurbed street, poles should be offset an appropriate distance from the pavement edge to avoid the striking by an errant vehicle, based on the design speed of the street and the location of a roadside ditch. Poles should be offset from street trees a sufficient distance to avoid tree foliage from interfering with normal light distribution. The exact minimum spacing is dependent on the mature height and spread of the trees along the street; therefore, the landscape architect and lighting design engineer should consult early in the design process to select an appropriate tree species to be compatible with the lighting and roadside environment.

Hilliard Standard Construction Drawing references. Local public commercial, industrial and mixed-use street light material specifications shall be as follows:

1. Pole Base – per Hilliard Standard Drawing SL-7
2. Pole and Luminaire Assembly – per Hilliard Standard Drawing SL-8
3. Service Enclosure – per Hilliard Standard Drawing SL-10
4. Conduit/Trench – per Hilliard Standard Drawing SL-6
5. Conductors – per Hilliard Standard Drawing SL-17

10.8 Conservation District Street Lighting

This section applies to all public streets located within the Conservation District. This district is characterized by a lower density or clustered development design. Attempts are made in the Conservation District to minimize the impact of development on the natural character of the area; therefore, lighting in this area is minimized.

Design Criteria. There is no defined lighting criterion for streets within the Conservation District except that intersections, roundabouts, and uncontrolled pedestrian crossings shall meet the minimum lighting criteria established in the table in Section 10.4.

Luminaire. Luminaire shall have a black powder coated aluminum housing mounted on a 1.5"x 3" aluminum decorative cross arm. See Hilliard Standard Drawing SL -14.

Pole. Pole shall be a 5" square aluminum tube. The nominal height of the pole located in a roundabout is 20'. The nominal height of the pole located at all other street intersections is 15'.

The nominal height of the pole located at all pedestrian crossings is 12'. See Hilliard Standard Drawing SL-13.

Service Enclosure. Service enclosure shall be a watertight, 1 phase 3 wire 2 breaker box mounted on a pressure treated 4"x6" wood post. See Hilliard Standard Drawing SL-9.

Pole Placement. Poles are placed only at intersections as follows:

- Local/Local Tee Intersection: 1 pole
- Local/Local 4-Way Intersection: 2 poles located at diagonal opposite corners
- Unsignalized Thoroughfare Plan street Intersection (Tee or 4-Way): 2 poles located at diagonal opposite corners
- Roundabout Intersections: In accordance with Chapter 8 of the *NCHRP Report 672 Roundabouts: An Informational Guide* (latest edition)
- Regional trail network crossings of a public street at an uncontrolled location (i.e. midblock or at a location where conflicting vehicular traffic is not required to stop): 2 poles located at diagonal opposite corners.

Hilliard Standard Construction Drawing references. Conservation District street light material specifications shall be as follows:

1. Pole Base – per Hilliard Standard Drawings SL-12 and SL-15
2. Pole - per Hilliard Standard Drawing SL-13
3. Luminaire Assembly – per Hilliard Standard Drawing SL-14
3. Service Enclosure – per Hilliard Standard Drawing SL-9
4. Conductors – per Hilliard Standard Drawing SL-17

10.9 Old Hilliard District Street Lighting

This section applies to all public streets located within the Old Hilliard District.

Luminaire. Luminaire shall have a cast aluminum housing with a black satin finish with LED lights. See Hilliard Standard Drawing SL-16.

Pole. Old Hilliard poles are 5-inch diameter, fluted with an octagonal base, made of structural grade aluminum, with a textured black finish. The nominal height of the pole is 14', including the base. See Hilliard Standard Drawing SL-13.

Service Enclosure. Service enclosure shall be a 30"H x 18"W x 15" D stainless steel watertight enclosure with a dark bronze powder coated finish. See Hilliard Standard Drawing SL-11.

Pole Placement. Poles should be located on both sides of the street and shall be placed within the buffer/furnishings zone. Poles shall be placed a minimum of 2' behind the back of curb. At intersection radii, poles shall be placed a minimum of 4' behind the back of curb. Poles should be

offset from street trees a sufficient distance to avoid tree foliage from interfering with normal light distribution. The exact minimum spacing is dependent on the mature height and spread of the trees along the street; therefore, the landscape architect and lighting design engineer should consult early in the design process to select an appropriate tree species to be compatible with the lighting and roadside environment.

Hilliard Standard Construction Drawing references. Old Hilliard street light material specifications shall be as follows:

1. Pole Base – per Hilliard Standard Drawing SL-16
2. Pole and Luminaire Assembly – per Hilliard Standard Drawing SL-16
3. Service Enclosure – per Hilliard Standard Drawing SL-9
4. Conduit/Trench – per Hilliard Standard Drawing SL-6
5. Conductors – per Hilliard Standard Drawing SL-17

10.10 Roundabout Lighting

Street lighting is required at all roundabouts. Roundabout lighting should be designed in accordance with Chapter 8 of *NCHRP Report 672 Roundabouts: An Informational Guide* (latest edition) in terms of design criteria and pole placement. Luminaire, pole, and material specifications shall per the type of street or district in which the roundabout is located. Pole placement at roundabouts shall be a *minimum* of 4' behind the back of curb; truck turning templates shall be used to evaluate truck tracking to ensure that poles are set back a sufficient distance based on the unique geometry of the roundabout.

Hilliard Standard Construction Drawing references. Roundabout public street light material specifications shall be as follows:

1. Typical Layout – per Hilliard Standard Drawing SL-18

10.11 Retrofit of Existing Lighting

The purpose of this section is to provide the City with a methodology for replacing existing high intensity discharge (HID) streetlights with broad spectrum (white) light streetlights, such as LED technology.

In conformity with standard lighting practice, the streetlight replacements merely replace in-kind; they are not designed to increase the lighting level of existing street lighting design standards. They are equivalent to the streetlight they replace in that they provide comparable visibility for the section of street illuminated by the existing light.

An LED replacement light is considered "equivalent" to the existing light if it can deliver an average illuminance within 10% of the existing average illuminance.

Hilliard Standard Construction Drawing references. Retrofit of public street light material specifications shall be as follows:

1. Typical Layout – per Hilliard Standard Drawing SL-19

10.12 Lighting of Private Property

Private site lighting components should be visually appealing and serve not only to illuminate the parking, drive, and walk areas but to enhance the aesthetic appearance of the City. Site lighting should be designed in a manner that focuses and directs lighting downward to minimize light pollution.

All developments with ten or more parking spaces are required to provide exterior lighting for all pedestrian walkways and vehicular use areas in accordance with Hilliard City Code. Deviation from this requirement may be approved through a variance.

Maximum Illumination at Property Lines. Lighting originating on a site shall not trespass beyond the site to exceed the following values when measured at grade, ten feet beyond the property line for the following adjacent property types:

Residential	0.3 footcandles
Multi Family	0.5 footcandles
Office/Commercial/Industrial	1.2 footcandles

Chapter 11: Green Infrastructure Improvements

11.1 Introduction

The City of Hilliard promotes the use of green infrastructure for all development. Green infrastructure uses vegetation, soils, and other natural processes to manage water and create healthier urban environments. It helps maintain healthy waters, provides environmental benefits, and helps support a sustainable community. Some examples of green infrastructure include, but are not limited to:

A. Bioswales
Bioswales are vegetated, shallow, landscaped depressions designed to capture, treat and infiltrate stormwater runoff as it moves downstream. They are typically sized to treat the first flush, which is the first and often most polluted volume of water following a storm event.

- Rain Gardens
- Permeable pavement
- Permeable pavers
- Green Roofs

For additional information on BMP's, see chapter 7 of this Manual.

B. Support the construction of buildings to utilize green building practices. Such changes as encouraging solar orientation of streets (and homes), encouraging development at a higher density with a larger open space requirement, and ensuring direct and convenient pedestrian and bike paths to area schools, parks, and retail uses are simple and inexpensive ways of improving the sustainability of Hilliard's future neighborhoods and mixed-use developments.

11.2 Stormwater Utility Credits

The City of Hilliard has established a stormwater utility credit program. See the appendix for more details.

Chapter 12: Landscape and Tree Standards

12.1 Introduction

Trees are essential to life and yet, they are sometimes taken for granted. Unfortunately, one million acres of forest are lost to city growth each year in the United States. The intent of this Section is to provide the minimum standards of landscape and tree plantings within Hilliard. Trees offer many benefits that are obscure to many, which include:

- Air Filtration- filters out particulate matter
- Purifies Water-improves water quality by slowing and filtering rain water
- Cost Reduction- provides shade and shelter, reducing yearly heating and cooling costs by 2.1 billion dollars
- Climate Control-obtained by moderating the effects of sun, wind, and rain
- Increase Property Value- well-cared for landscape properties are 5-20% more valuable than non-landscaped properties.
- Protection- reducing storm run-off and the possibility of flooding (erosion control)
- Glare and Reflection Control –filters out bright sun
- Wind Break, Deflection, and Filtration - obtained by moderating the effects of sun, wind, and rain.
- Sound Barrier- filters out loud noise.

Since trees are a growing asset to any property, maintenance of the trees is crucial for long-term health, safety, and aesthetic value. Many people do not realize that trees have a dollar value of their own. Competent tree appraisers can determine the dollar value of your trees and plants by evaluating the size, type (classification), condition, and location of the tree.

The best way to prepare for an unfortunate and unexpected loss is to take precautionary measures. Even though trees provide many values, hazardous trees can cause significant damage to people's homes if unfavorable conditions exist.

1. Plan your landscape for both beauty and functional value.
2. Protect and preserve to maintain worth.
3. Take pictures of trees and other landscape plants while they are healthy.
4. Check your insurance.
5. Keep accurate records of your landscape and real estate appraisals.
6. Consult an ISA Certified Arborist (http://www.isa-arbor.com) every stage in the life of your landscape to prevent unnecessary financial loss when casualty strikes.

12.2 Species and Plantings

All species listed within Section 12.2 are for the purpose of meeting the requirements as outlined within the Code, with the exception of Section D, Prohibited Species. Species listed in Section D shall not be permitted regardless of code requirements. Any applicant wishing to meet the requirements of the Code with any species other than what is listed within this Section may appeal to the City Planner or Director of Public Service, who will consult with the Shade Tree Commission to make a determination. The Shade Tree Commission will determine if the proposed species is in keeping with the intent of the code requirements.

A. Trees

1.) Small Tree

- Lawn widths 4'-5' and/or existing overhead utilities
- Mature size 25' or less in height

Common Name	Botanical Name
Trident Maple	*Acer buergerianum*
Amur Maple	*Acer ginnala*
Tatarian Maple	*Acer tataricum*
Red Buckeye	*Aesculus pavia*
Columnar Serviceberry	*Amelanchier „Cumulus"*
Allegheny Serviceberry	*Amelanchier laevis*
Apple Serviceberry	*Amelanchier x grandifolia*
American Hornbeam	*Carpinus caroliniana*
White Fringetree	*Chionanthus vurginicus*
Kousa Dogwood	*Cornus kousa*
Corneliancherry Dogwood	*Cornus mas*
Corneilian Cherry	*Cornus mas „Golden Glory"*
Thorneless Hawthorn	*Crataegus crusgalli var. inermis*
'Ohio Pioneer' Hawthorn	*Crataegus punctata var. inermis*
Common (thornless) Hawthorn	*Crataegus var. inermis*
'Winter King' Hawthorn	*Crataegus viridis*
Merrill Magnolia	*Magnolia x lobneri „Merrill"*
Flowering Crabapple	*Malus*
Crabapple (No fruit)	*Malus „Spring Snow"*
Crabapple	*Malus species*
American Hophornbeam	*Ostrya virginiana*
'Kwanzan' Cherry	*Prunus serrulata*
'Canada Red Select' or 'Schubert' Cherry	*Prunus virginiana*
Japanese Tree Lilac	*Syringa reticulata*
Ivory Silk Japanese Tree Lilac	*Syringa reticulata „Ivory Silk"*

2.) Medium Tree

- Lawn widths 6'-8'
- Mature size 25'-40' in height

Common Name	Botancial Name
Hedge Maple	*Acer campestre*
Freeman Maple	*Acer freemani*
Miyabe Maple State Street	*Acer miyabei „Morton"*
Purpleblow Maple	*Acer truncatum*
Ruby Red Horsechesnut	*Aesculus carnea „Briotii"*

Whitespire, Heritage Birch	*Betula platyphylla var. japonica*
Upright European Hornbeam	*Carpinus betulus „Fastigiata"*
American Yellowwood	*Cladrastis kentukea (lutea)*
Turkish Filbert	*Corylus colurna*
Washington Hawthorn	*Crataegus phaenopyrum*
Hardy Rubber Tree	*Eucommia ulmoides*
Carolina Silverbell	*Halesia carolina*
Golden Rain Tree	*Koelreuteria paniculata*
Black Gum	*Nyssa sylvatica*
American Hophornbeam	*Ostrya virginiana*
Amur Cork tree	*Phellodendiron amurence*
Sargent Cherry	*Prunus sargentii*
Japanese Flowering Cherry	*Prunus serrulata species*
Jac or Jill Flowering Pear	*Pyrus c. „Jac" or „Jill"*
Sawtooth Oak	*Quercus acutissima*
Shumard Oak	*Querucus shumardii*
Corinthian Little Leaf Linden	*Tilia cordata „ Corzam"*
Greenspire Little Leaf Linden	*Tilia cordata „Greenspire"*
Sterling Silver Linden	*Tilia tomentosa „Sterling"*
Lacebark Elm	*Ulmus parvifolia*
Patriot Elm	*Ulmus x „Patriot*

3.) Large Tree

- Lawn widths 8’ or greater
- Mature size 40’ and over in height

Common Name	**Botancial Name**
Norway Maple	*Acer platanoides*
Sugar Maple	*Acer saccharum*
Freemani Maple	*Acer x freemani*
Avalzam Birch	*Betula x ‘Avalzam’*
European Hornbeam	*Carpinus betulus*
Sugar Hackberry	*Celtis laevigata*
Common Hackberry	*Celtis occidentalis*
Prairie Pride Hackberry	*Celtis occidentalis ‘Prairie Pride’*
Katsuratree	*Ceridiphyllum japonicum*
Turkish Filbert	*Corylus colurna*
Hardy Rubber Tree	*Eucommia ulmoides*
Ginkgo (male forms only please)	*Ginkgo biloba*
Thornless Honeylocust	*Gleditsia triacanthos var. inermis*
Kentucky Coffeetree	*Gymnocladus dioicus*
European Larch	*Larix deciduas*
Sweetgum	*Liquidambar styraciflua*
Tuliptree, Yellow Poplar	*Liriodendron tulipifera*
Sweetgum	*Lyquidamber styraciflua*
Dawn Redwood	*Metasequoia glyptostroboides*
Sycamore	*Platanus occidentalis*
London Plane Tree	*Platanus x acerfolia „ Exclamation"*
Sawtooth Oak	*Quercus acutissima*
Swamp White Oak	*Quercus bicolor*
Scarlet Oak	*Quercus coccinea*
Shingle Oak	*Quercus imbricaria*
Bur Oak	*Quercus macrocarpa*
Chinkapin Oak	*Quercus muehlenbergii*
Red Oak	*Quercus rubra*

Shumard Oak	*Quercus shumardii*
Regal Prince Oak	*Qurecus robur "Long"*
Japanese Pagodatree	*Sophora japonica*
Bald Cypress	*Taxodium ditichum*
American Linden	*Tilia americana*
Silver Linden	*Tilia tomentosa*
Princeton American Elm	*Ulmus americana „Princeton"*
Valley Forge Elm	*Ulmus americana „Valley Forge"*
Dynasty Elm	*Ulmus parvifolia „Dynasty"*
Frontier Elm	*Ulmus parvifolia „Frontier"*
Accolade Elm	*Ulmus x „Morton"*
Elm species	*Ulmus x spp*
Japanese Zelkova	*Zelkova serrate*

4.) Evergreen Tree

- Lawn widths: 8' or greater
- Mature size: 40' and over in height

Common Name	Botancial Name
White Fir	*Abies concolor*
Norway Spruce	*Picea abies*
White Spruce	*Picea glauca*
Serbian Spruce	*Picea omorika*
Colorado Spruce	*Picea pungens*
Douglas Fir	*Pseudotsuga menziesii*
Canadian Hemlock	*Tsuga canadensis*

B. Shrubs and Grasses

1.) Shrubs

- Lawn widths: 2' or greater
- Mature size: 2'or greater

Common Name	Botancial Name
Little Leaf Boxwood	*Buxus microphylla*
Common Boxwood	*Buxus sempervirens*
Falsecypress	*Chamaecyparis obtusa*
Nordic Holly	*Ilex glabra 'Chamzin'*
Blue Holly	*Ilex x meserveae*
Chinese Juniper	*Juniperis chinensis (many cultivars)*
Rocky Mountain Juniper	*Juniperis scopulorum (many cultivars)*
Pyramidal Japanese Yew	*Taxus cupsidata 'Capitata'*
Media Yew	*Taxus x media (many cultivars)*
Dark Green Arborvitae	*Thuja occidentalis (many cultivars)*

2.) Ornamental Grasses

- Lawn widths 2' or greater
- Mature size 2' or greater
- All ornamental grasses must be "clumping" type. Rhizomatous ornamental grasses shall not acceptable for required plantings.

Common Name	Botancial Name
Media Yew	*Taxus x media (many cultivars)*
Maiden Grass	*Miscanthus sinensis*"Gracillimus"
Zebra Grass	*Miscenthus sinensis*"Zebrinus"

Porcupine Grass	*Miscanthus sinensis* "Stricta"
Morning Light Grass	*Miscanthus sinensis* "Morning Light"
Silver Grass	*Miscanthus sinensis*"Variegatus"
Blue Oat Grass	*Helictotrichon semperviren*
Blue Fescue	*Festuca ovina*
Tufted Hair Grass	*caespitosa*

C. Native Prairie Grasses and/or Wildflowers

1.) Prairie Grasses

Common Name	Botancial Name
Big Bluestem	*Andropogon gerardii*
Little Bluestem	*Schizachyrium scoparium*
Indian Grass	*Sorghastrum nutans*
Switch Grass	*Panicum virgatum*

2.) Wildflower Pockets

Common Name	Botancial Name
Nodding Wild Onion	*Allium cernuum*
Butterfly Weed	*Asclepias tuberosa*
Canadian Milk Vetch	*Astragalus canadensis*
Indian Paintbrush	*Castilleja coccinea*
Partridge Pea	*Chamaecrista fasciculata*
Purple Coneflower	*Echinacea purpurea*
Tall Boneset	*Eupatorium altissimum*
Flowering Spurge	*Euphorbia corollata*
Stiff Gentian	*Gentiana quinquefolia*
Sawtooth Sunflower	*Helianthus grosseserratus*
Ox Eye Sunflower	*Heliopsis helianthoides*
Dense Blazingstar	*Liatris spicata*
Scaly Blazingstar	*Liatris squarrosa*
Wild Bergamot	*Monarda fistulosa*
Grey-Headed Coneflower	*Ratibida pinnata*
Black-eyed Susan	*Rudbeckia hirta*
Prairie Dock	*Silphium terebinthinaceum*
Whorled Rosinweed	*Silphium trifoliatum*
Riddell's Goldenrod	*Solidago riddellii*
Stiff Goldenrod	*Solidago rigida*
Ohio Spiderwort	*Tradescantia ohiensis*

3.) No-Mow Turf

Common Name	Botancial Name
Hard Fescue	*Festuca brevipila*
Sheep Fescue	*Festuca ovina*
Chewings Fescue	*Festuca rubra subs. fallax*
Red Fescue	*Festuca rubra*
Creeping Red Fescue	*Festuca rubra var. rubra*

4.) Naturalized

- *As approved by the City Planner and / or Shade Tree Commission*

5.) Temporary Cover Crop

Common Name	Botancial Name
Winter Rye Grass / Grain Rye	*Secale cereal*

D. Prohibited Species

1.) Trees

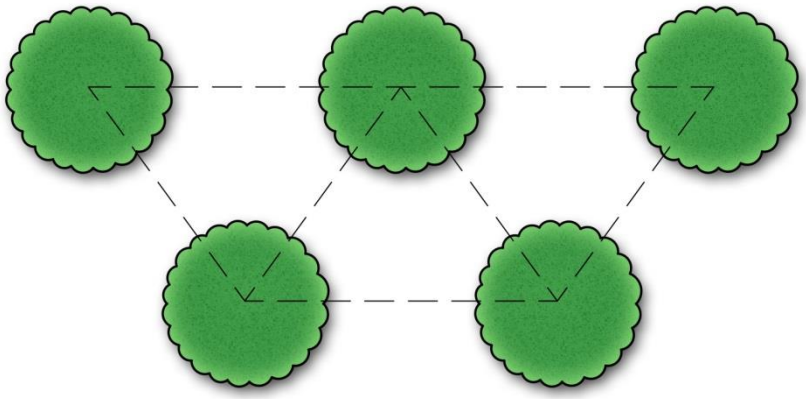
Common Name	Botancial Name
Box Elder	*Acer negundo*
Silver Maple	*Acer saccharinum*
Tree of Heaven	*Ailanthun altissima*
Paper Birch	*Betula papyrifera*
European White Birch	*Betula pendula*
Northern Catalpa	*Catalpa speciosa*
Green Ash	*Fraxinus pennsylvanica*
White Ash	*Fraxinus americana*
Black Ash	*Fraxinus nigra*
Ginkgo (female)	*Ginkgo biloba*
Osage-orange	*Maclura pomifera*
Apple	*Malus pumila*
Mulberry	*Morus species*
White Pine	*Pinus strobus*
Austrian Pine	*Pinus nigra*
Poplar	*Populus species*
Bradford Pear 'Bradford'	*Pyrus calleryana 'Bradford'*
Columnar English Oak	*Quercus robur 'Fastigiata'*
Black Locust	*Robinia pseudoacacia*
Willow	*Salix species*
European Mountain Ash	*Sorbus aucuparia*
Siberian Elm	*Ulmus pumila*

E. Placement

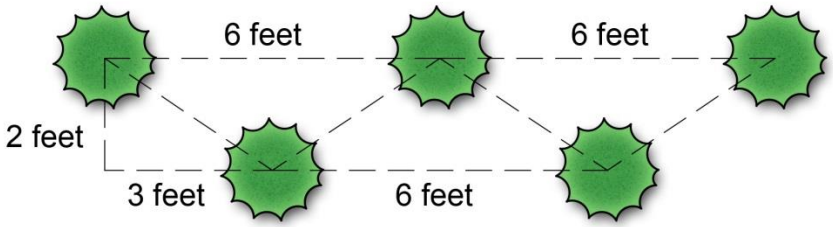
1.) **Clustering -** Where trees are required based on a linear footage calculation, it may be possible for these trees to be planted in clusters as opposed to being evenly space in a line. In the case where clustering is used, no tree shall be located any closer than ten (10) feet, or any further than fifty (50) feet from the next closest required tree. Any such clustering plan must be approved by the Director of Public Service prior to installation of the landscaping.

2.) **Staggering -** When required for perimeter parking landscaping and buffering, trees and shrubs may be required to be planted in staggered rows to provide the effective diagonal planting of the plants.

   a. **Tree Staggering -** Trees should be planted in a manner to provide for equal spacing both in width and depth between each plant.



b. **Shrub Staggering -** Shrubs should be planted in an alternating pattern formed by at least two rows, two (2) feet apart on center, each of which is made up of shrubs six (6) feet on center.

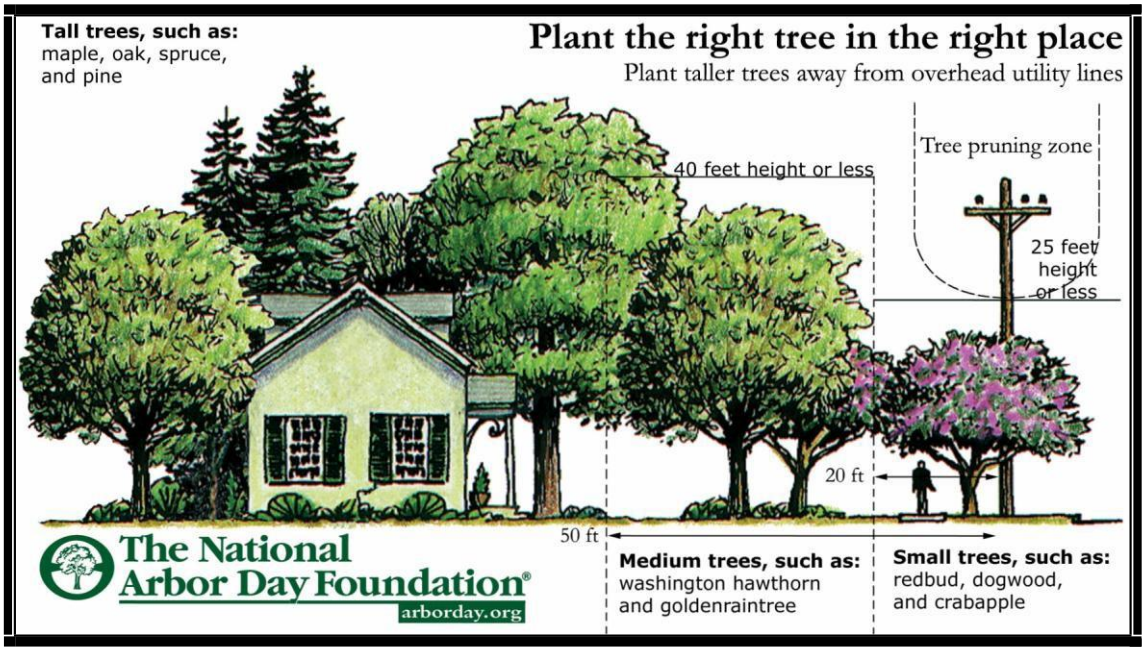


12.3 Hilliard Tree Manual

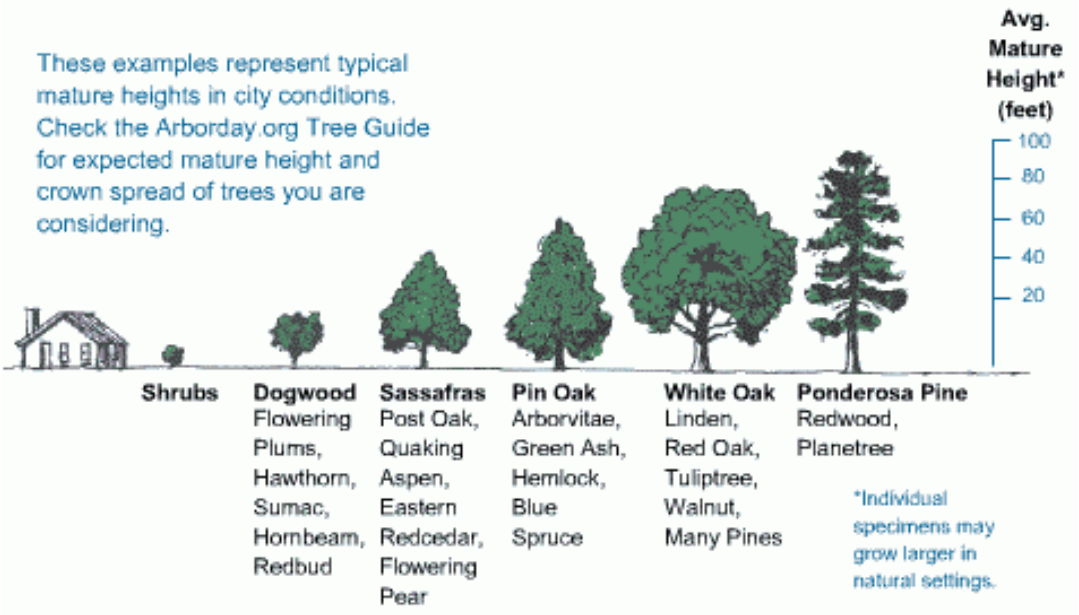
A healthy community forest begins with careful planning. With a little research and a simple layout, you can produce a landscape that will cool your home in summer and tame the winter winds. Your well-planned yard will contain trees that grow well in the soil and moisture of your neighborhood. Your trees will be properly placed to avoid collisions with power lines and buildings, and the aesthetics will increase your property value.

A proper landscape plan takes each tree into consideration:

1. **Height.** Will the tree bump into anything when it is fully grown?
2. **Canopy spread.** How wide will the tree grow?
3. **Is the tree deciduous or coniferous?** (Will it lose its leaves in the winter?)
4. **Form or shape.** A columnar tree will grow in less space. A round and V-shaped species provide the most shade.
5. **Growth rate.** How long will it take for your tree to reach its full height? Slow growing species typically live longer than fast growing species.
6. **Soil, sun, and moisture** requirements.
7. **Fruit.** No one wants messy droppings on busy sidewalks.
8. **Hardiness zone** indicates the temperature extremes in which a tree can be expected to grow. Check with your community's shade tree commission or state forestry department or a local county cooperative extension agent for a list of trees suitable for planting in your specific hardiness zone.

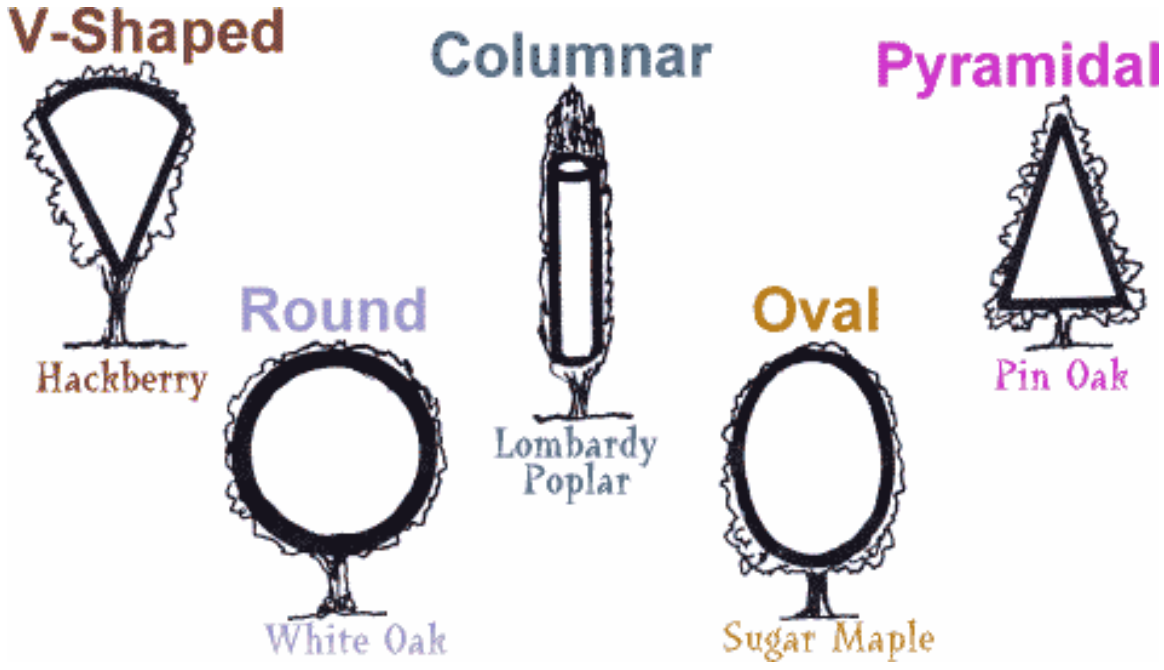


Available space is probably the consideration most overlooked or misunderstood when deciding what tree to plant. Before you plant, it is important to know what the tree will look like as it nears maturity. Consider its height, crown spread, and root space.



Basic Spacing Guide			
	Spacing plant	Min. spacing from wall of 1- story building	Min. spacing from corner of 1- story building
Small trees (30' or less)	6-15'	8-10'	6-8'
Medium trees (30-70')	30-40'	15'	12'
Large trees (70' or more)	40-50'	20'	15'

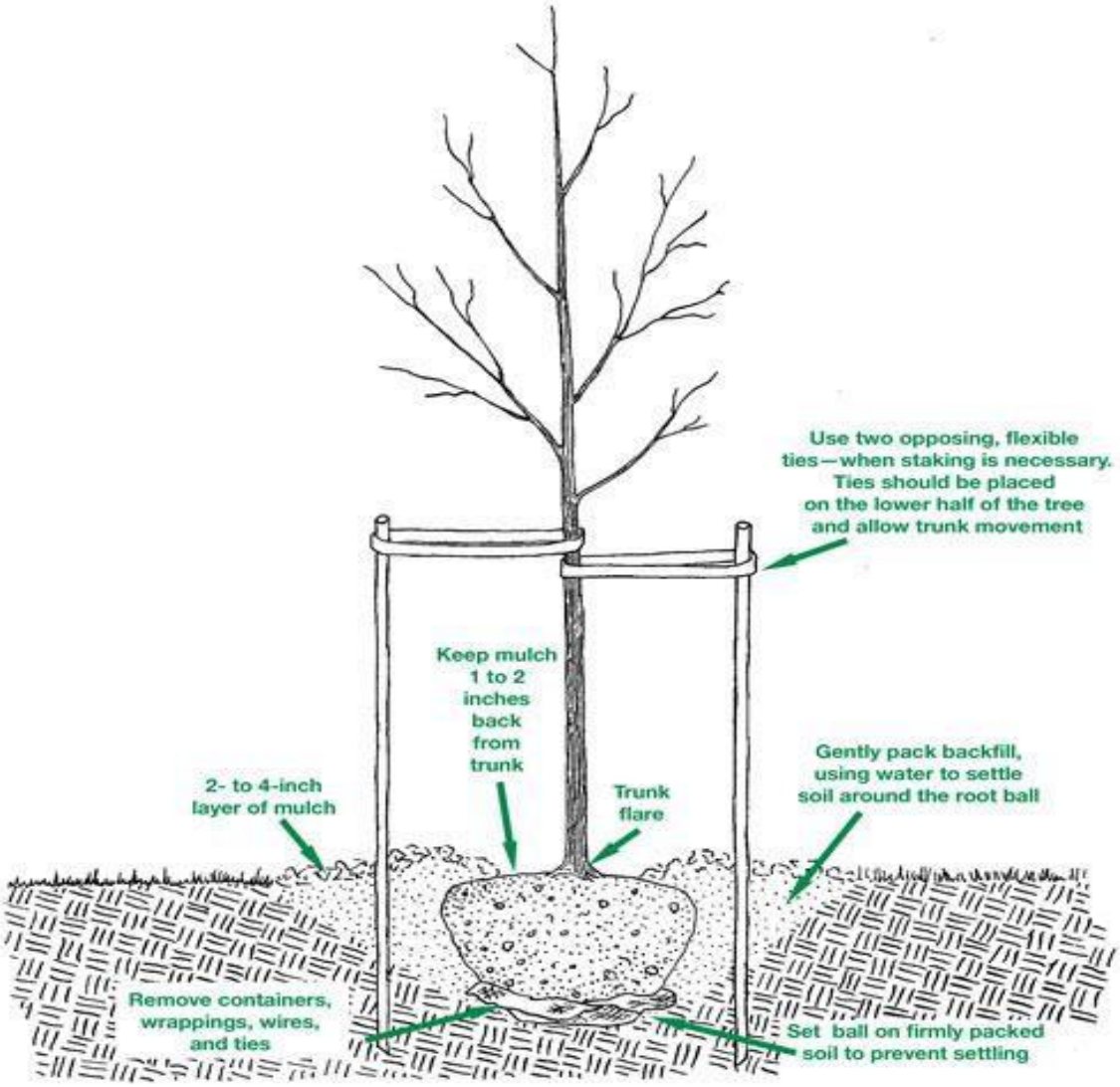
The character of tree crowns and the form or shape of trees varies among species as much as leaves shapes or bark patterns. Shape is another clue to how well a tree will fit the space you have available, what problems might occur, and how well it will help meet the goals you have for your property.



12.3.1 Proper Planting Guidelines

The ideal time to plant trees and shrubs is during the dormant season, autumn after leaf drop or early spring before bud-break. Weather conditions are cool and allow plants to establish roots in the new location before spring rains and summer heat stimulate new top growth. However, trees properly cared for in the nursery or garden center, and given the appropriate care during transport to prevent damage, can be planted throughout the growing season. Proper handling during planting is essential to ensure a healthy future for new trees and shrubs. Before you begin planting your tree, be sure you have had all underground utilities located prior to digging.

Call before you Dig
Ohio Utilities Protection Service (OUPS) (800)-362-2764 (OUPS)



12.3.2 Planting Balled and Burlapped Trees

1. **Dig a shallow, broad planting hole.** Make the hole wide, as much as three times the diameter of the root ball but only as deep as the root ball. It is important to make the hole wide because the roots on the newly establishing tree must push through surrounding soil in order to establish. On most planting sites in new developments, the existing soils have been compacted and are unsuitable for healthy root growth. Breaking up the soil in a large area around the tree provides the newly emerging roots room to expand into loose soil to hasten establishment.

2. **Identify the trunk flare.** The trunk flare is where the roots spread at the base of the tree. This point should be partially visible after the tree has been planted (see diagram). If the trunk flare is not partially visible, you may have to remove some soil from the top of the root ball. Find it so you can determine how deep the hole needs to be for proper planting.

3. **Remove twine from the root ball.** Lifting only from the bottom of the root ball, position tree on firm pad so that it is straight and top of root flare is level with the surrounding soil. Remove all twine from the root ball. If present, remove and discard at least the top one half of the wire basket. Burlap shall be removed from the top to a point halfway down the root ball and discarded.

4. **Place the tree at the proper height.** Before placing the tree in the hole, check to see that the hole has been dug to the proper depth... The majority of the roots on the newly planted tree will develop in the top 12 inches of soil. If the tree is planted too deeply, new roots will have difficulty developing because of a lack of oxygen. It is better to plant the tree a little high, 2 inches above the base of the trunk flare, than to plant it at or below the original growing level. This planting level will allow for some settling (see diagram). To avoid damage when setting the tree in the hole, always lift the tree by the root ball and never by the trunk.

5. **Straighten the tree in the hole.** Before you begin backfilling, have someone view the tree from several directions to confirm that the tree is straight. Once you begin backfilling, it is difficult to reposition the tree.

6. **Fill the hole gently but firmly.** Fill the hole about one-third full and gently but firmly pack the soil around the base of the root ball. Then, if the root ball is wrapped, cut and remove any fabric, plastic, string, and wire from around the trunk and root ball to facilitate growth (see diagram). Be careful not to damage the trunk or roots in the process. Fill the remainder of the hole, taking care to firmly pack soil to eliminate air pockets that may cause roots to dry out. To avoid this problem, add the soil a few inches at a time and settle with water. Continue this process until the hole is filled and the tree is firmly planted. It is not recommended to apply fertilizer at the time of planting.

   Stake the tree, if necessary. If the tree is grown and dug properly at the nursery, staking for support will not be necessary in most home landscape situations. Studies have shown that trees establish more quickly and develop stronger trunk and root systems if they are not staked at the time of planting. We recommend to only stake tree if tree trunk moves with-in the root-ball. Remember to remove support staking and ties after the first year of growth.

7. **Mulch the base of the tree.** Mulch is simply organic matter applied to the area at the base of the tree. It acts as a blanket to hold moisture, and it moderates soil temperature extremes. A 2- to 3-inch layer is ideal.

12.3.3 Planting Containerized or Grow Bag Trees:

1. If not readily apparent, locate root flare by removing excess soil.

2. Dig tree hole at least two times wider than the tree ball with sloping sides. Dig hole to a depth so the located root flare, at the first order lateral root, will be at finished grade.

3. Create a firm soil mound at the bottom of the planting hole.

4. Remove tree from container or grow bag and completely tease apart root system, repositioning any girdling or potentially girdling roots.

5. Spread roots over soil mound so that root flare is at finished grade and the tree is straight.

6. With clean, sharp pruning tools, prune off any secondary/adventitious, girdling, and potential girdling roots.

7. Backfill planting hole with existing un-amended soil and thoroughly water.

8. Mulch the entire planting surface with composted bark applied no less than two inches (2") deep and no more than three inches (3") deep, leaving three inches (3”) adjacent to the tree trunk free of mulch.

12.3.4 Planting Bare Root Trees:

1. Dig tree hole at least two times wider than the tree root ball with sloping sides. Dig hole to a depth so the located root flare, at the first order lateral root, will be at finished grade.

2. Create a firm soil mound at the bottom of the planting hole.

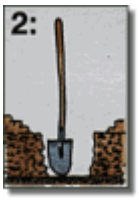
3. Spread roots over soil mound so that root flare is at finished grade and the tree is straight.

4. With clean, sharp pruning tools, prune off any secondary/adventitious, girdling, and potential girdling roots.

5. Backfill planting hole with existing un-amended soil and thoroughly water.

6. Mulch the entire planting surface with composted bark applied no less than two inches (2") deep and no more than three inches (3") deep, leaving three inches (3") adjacent to the tree trunk free of mulch.

Unpack tree and soak in water 3 to 6 hours. Do not plant with packing materials attached to roots, and do not allow roots to dry out.



Plant the tree at the same depth it stood in the nursery, without crowding the roots. Partially fill the hole, firming the soil around the lower roots. Do not add soil amendments.

After the water has soaked in, place a 2-inch deep protective mulch area 3 feet in diameter around the base of the tree (but not touching the trunk).

Dig a hole, wider than seems necessary, so the roots can spread without crowding. Remove any grass within a three-foot circular area. To aid root growth, turn soil in an area up to 3 feet in diameter.

Shovel in the remaining soil. It should be firmly, but not tightly packed with your heel. Construct a water-holding basin around the tree. Give the tree plenty of water.

Water the tree generously every week or 10 days during the first year.

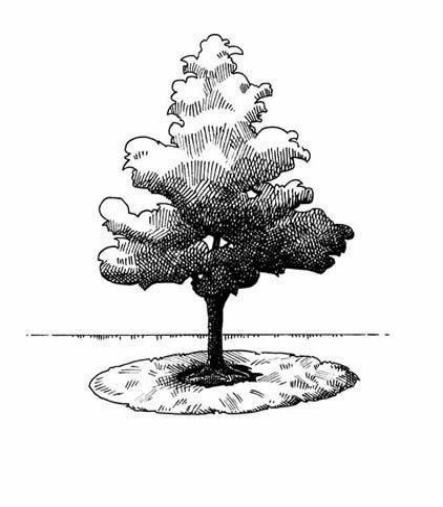
12.3.5 Mulching:

Studies show that a mulched tree can grow double or even triple the rate of an un-mulched tree. So not only will mulch add artistic flair to your landscape, it will help you develop a good root system and a generally healthy tree by:

- insulating soil
- retaining moisture
- blocking weeds
- keeping soil from compacting
- protecting against lawnmower damage

How deep should mulch be? The ideal depth is two to three inches. If you're using shredded hardwood mulch, lay it about four inches deep to allow for settling.

Do Not Volcano Mulch



Do Mulch Correctly

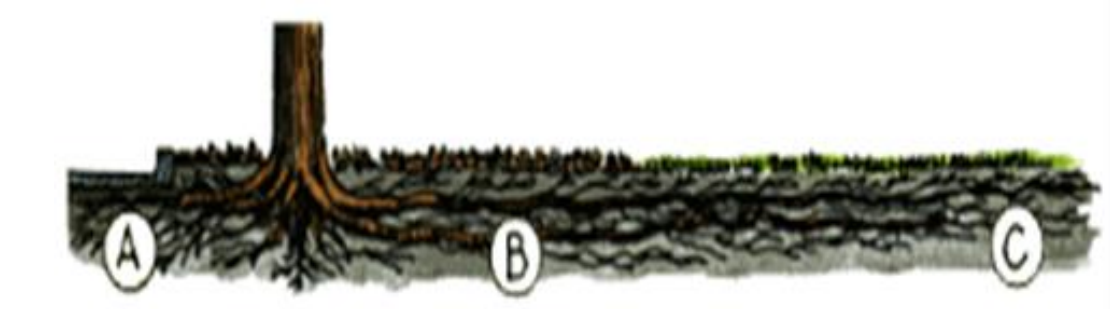
A properly mulched tree will have a 2 to 3 inch layer of mulch in a doughnut shaped ring. The ring should extend out to the tree's drip line if possible.

What kind of mulch should you use? There are two basic types of mulch: organic and inorganic. Organic mulches, derived from plant material, decompose to enrich and improve the soil. Manure, sphagnum peat moss and pine needles are all examples of organic mulch. The most popular mulch for both weed control and longevity is shredded hardwood, chip, or chunk bark. This allows for better water and air movement to the soil and tree roots.

Provide follow-up care. Keep the soil moist but not soaked; over-watering causes leaves to turn yellow or fall off. Trees should be water once at least once a week (barring rain) and more frequently during hot weather. When the soil is dry below the surface of the mulch, it is time to water. Continue until mid-fall, tapering off for lower temperatures that require less-frequent watering.

If a tree is planted correctly, it will grow twice as fast and live at least twice as long as one that is incorrectly planted. Ideally, dig or rot till an area one foot deep and approximately 3 times the diameter of the root ball. The prepared soil will encourage root growth beyond the root ball and results in a healthier tree.

12.3.6 Where Roots Really Grow



A: Because roots need oxygen, they don't normally grow in the compacted oxygen-poor soil under paved streets.

B: The framework of major roots usually lies less than 8 to 12 inches below the surface.

C: Roots often grow outward to a diameter one to two times the height of the trees.

We don't always appreciate how far roots can extend. Understanding how and where roots grow will help you avoid damage from trenching and construction. Basic elements that influence plant health include sufficient water and light, and a proper balance of nutrients. Too much or too little of any of these environmental conditions may cause plant stress.

After investing countless hours of hard labor and hard-earned dollars on tree landscaping, the last thing you need is to see your efforts ruined by an onslaught of disease and insects. The first step in protecting your valuable green assets is prevention. Be sure to plant trees that are well suited to your location and that are resistant to common insect and disease infestations. Most insects and diseases take advantage of plants that are under stress so watering, mulching, and pruning are essential to preventing outbreaks. Proper diagnosis is also the key to treating the problem.

12.3.7 Why Hire an Arborist?

An arborist is a specialist in the care of individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care. Hiring an arborist is a decision that should not be taken lightly. Proper tree care is an investment that can lead to substantial returns. Well-cared-for trees are attractive and can add considerable value to your property. Poorly maintained trees can be a significant liability. Pruning or removing trees, especially large trees, can be dangerous work. Tree work should be done only by those trained and equipped to work safely in trees. There are several categories for Certification as an Arborist.

The ISA Certification credential can be viewed as a pyramid with the largest group in the base. These credentials were developed based on the knowledge required to obtain each one.

What Is a Certified Arborist?

Certified Arborists are individuals who have achieved a level of knowledge in the art and science of tree care through experience and by passing a comprehensive examination developed by some of the nation‟s leading experts on tree care. Certified Arborists must also continue their education to maintain their certification. Therefore, they are more likely to be up to date on the latest techniques in arboriculture.

To check for a certified arborist in your area go to
http://www.isaarbor.com/findArborist/findarborist.aspx

Welcome to the City of Hilliard Service Request Center

City of Hilliard Service Request Center *http://src.hilliardohio.gov/*

The City of Hilliard has provided this site to aid our residents, employees, and corporate customers in finding information, making inquiries, and requesting city services. The Hilliard Service Request Center (SRC) is available online 24-hours-a-day, 365-days-a-year for your convenience.

To begin, please enter your e-mail address and password in the boxes below, or if you don't have a user account, please click on the 'Create a user account' link. User accounts are free, and only take a few minutes to set up. User accounts are required to access the features of this site, and they allow us to contact you should the need arise. Users should read the City's privacy policy prior to creating a user account.

Information concerning various city services, city requirements, city codes, recreation opportunities and various other items are available through the following topic search or list menu. Each topic also has a service request form available by following the associated link. Use either the "Topic Keyword Search" or select the appropriate category and topic in the list boxes below, and then proceed by following the on-screen directions.

Usage Notes:

You have selected the Street Trees category. Please select a request type from the types list in order to continue.

Street Tree Tips

Here are some very important and helpful tips to keep your street tree healthy and growing for decades. Please remember these trees were planted to add value and beauty to your home and to the neighborhood

- **City Tree or Mine?**

Street trees are planted in the City right of way or easement generally located between the sidewalk and street. These trees are considered property of the public. The City of Hilliard typically handles the planting, pruning, and removal of these trees. Homeowners are asked to cooperate with the City by watering, mulching, and removing the sucker growth located at the base of the tree.

According to the City of Hilliard's Street Tree Ordinance, developers are responsible for the installation of new street trees. *"If"* the tree dies within the first year of planting the developer must replace it. If the tree dies after the first year the City of Hilliard will replace it. The City will notify the homeowner of planting, pruning, and the removal of street trees.

- **Please water -** A slow running hose at the base of the tree for a half hour once a week could save its life. We recommend 10- 20 gallons of water once a week, depending on the size of the tree to be installed.

- **Thank you for mulching -** Remember to keep the mulch away from the tree trunk bark. Mulch applied high around the base of the tree bark will create a dark and moist environment, perfect for harboring disease and insects.

- **Please remove ugly sucker-growth -** *(*suckers: A secondary shoot produced from the base or roots of a woody plant that gives rise to a new plant)

This secondary growth is located around the base of the tree. Sucker growth is not only unattractive, but also can harbor disease and insects. Simply prune the sucker- growth off as close to the ground as possible.

Street Tree Tips

Your Street Trees May Be City Trees

If you live in a town or city, the trees near the street (often between the sidewalk and street), are probably city-owned. The city should have a program for planting and caring for these trees. You should support your city forestry program and encourage your town to be a Tree City U.S.A.

Respect local ordinances as to what trees can be planted, how to prune, etc. Encourage your town to fully fund a quality community forestry program.

Street trees are planted in the City right of way or easement generally located between the sidewalk and street. These trees are considered property of the public. The City of Hilliard typically handles the planting, pruning, and removal of these trees. Homeowners are asked to cooperate with the City by watering, mulching, and removing the sucker growth located at the base of the tree.

Street Tree Planting Requirements

All builders are required to plant large or medium trees along the public streets of their developments in such a manner, type, quantity and location as required by the Enforcement Officer, who may consult with the Shade Tree Commission. Any undeveloped street or existing street with undeveloped frontage shall conform to these requirements at the time of occupancy of each unit. Small trees may be used upon application to and permission from the Enforcement Officer. Such request may be granted upon the showing by the applicant that the small trees are more appropriate for the area.

The tree to be planted must be a desirable tree species, as determined by the Enforcement Officer, in consultation with the Shade Tree Commission and the Master Street Tree Plan.

The tree location is to be at least thirty feet from street intersections and ten feet from fire hydrants, utility poles or drives.

Tree Fun Facts

The following are some statistics on just how important trees are in a community.

"The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating
20 hours a day."— *U.S. Department of Agriculture*

"Landscaping can reduce air conditioning costs by up to 50 percent, by shading the windows and walls of a home." — *American Public Power Association*

"If you plant a tree today on the west side of your home, in 5 years your energy bills should be 3% less. In
15 years the savings will be nearly 12%." — *Dr. E. Greg McPherson, Center for Urban Forest Research*

"A mature tree can often have an appraised value of between $1,000 and $10,000." —*Council of Tree and Landscape Appraisers*

"In one study, 83% of realtors believe that mature trees have a "strong or moderate impact" on the salability of homes listed for under $150,000; on homes over $250,000, this perception increases to 98%." — *Arbor National Mortgage & American Forests*

"Landscaping, especially with trees, can increase property values as much as 20 percent."— *Management Information Services/ICMA*

"One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people."— *U.S. Department of Agriculture*

"There are about 60 to 200 million spaces along our city streets where trees could be planted. This translates to the potential to absorb 33 million more tons of CO2 every year, and saving $4 billion in energy costs."— *National Wildlife Federation*

The Biggest Tree in the United States is "The General Sherman Tree"
Giant Sequoia in California

- Its circumference is 1013 inches or 84.42 feet
- Its diameter is 322.6115 inches or 26.8853 feet
- Its trunk has a volume of 50, 000 cubic feet
- It is 275 tall
- It is 107 feet in average crown spread

America's National Tree The Oak. America has the grandest trees on earth--the largest, the oldest, and some of the most magnificent. Now, with Congressional passage and presidential signing of a historic bill, America has an official National Tree--the Oak.

City of Hilliard Tree Percentages

Common Names/*Botanical Names*	# Trees	%
Freeman Maples *Acer x „Freemanii"*	529	6.00%
Hedge Maple *Acer campestre*	178	2.00%
Norway Maples *Acer platanoides*	1000	10%
Red Maples *Acer rubrum*	338	3%
Sugar Maples *Acer saccharum*	335	3%
Serviceberry *Amelanchier*	142	2%
River Birch *Betula nigra*	103	1%
Redbud *Cercis canadensis*	60	1%
Hawthorns *Crateagus*	88	1%
Hardy Rubber Tree *Eucommia ulmoides*	27	1%
White & Green Ash *Fraxinus americana & pennsylvanica*	1457	15%
Gingko *Gingko bilboa*	48	1%
Honeylocust *Gledlitisia*	551	6%
Kentucky Coffee Trees *Gymnocladus dioicus*	106	1.00%
Sweetgum *Liquidambar*	502	5%
Crabapples *Malus*	692	8%
Austrian Pines *Pinus nigra*	10	1.00%
Cherry *Prunus* Callery	29	1.00%
Pears *Pyrus calleryana*	1236	14%
Pyramidal English Oak *Quercus robur 'Fastigiata*	37	1.00%
Red Oak *Qurecus rubra*	379	4%
Ivory Silk Lilac *Syringa reticulata „Ivory Silk"*	97	1%
Little Leaf Lindens *Tilia cordata*	412	5%
Lacebark Elms *Ulmus parvifolia*	410	5%
Zelkova	74	1%

Street Tree Requirements

- The tree to be planted must be a desirable tree species, as determined by the Enforcement Officer, in consultation with the Shade Tree Commission and the Master Street Tree Plan.

- The minimum spacing between the new street tree(s) and other trees shall be forty-five feet for large trees, thirty-five feet for medium trees, and twenty-five feet for small trees. (See Definitions) The maximum spacing between trees shall be fifty feet for large trees, forty feet for medium trees, and thirty feet for small trees.

- The minimum distance between the tree and the edge of the street shall be four feet for a large tree, three feet for a medium tree and two feet for a small tree. In areas where a sidewalk exists or is proposed, the minimum distance between the tree trunk and both the edges of the street and the sidewalks shall be four feet for a large tree, three feet for a medium tree, and two feet for a small tree, thereby creating a minimum of an eight foot tree lawn for large trees, six foot tree lawn for medium tree and four foot tree lawn for small trees.

- The tree location is to be at least thirty feet from street intersections and ten feet from fire hydrants, utility poles or drives.

- A small tree is to be used when planting under or within ten lateral feet of overhead utility wires. A small or medium tree is to be used when planting within ten to twenty lateral feet of overhead utility wires

- The trees shall be of the genus and species as approved by the Enforcement Officer, who may consult with the Shade Tree Commission, to be planted continuous down each street as per the Master Street Tree Plan.

Street Tree Inspection

The Enforcement Officer shall inspect and approve the tree following planting. The minimum trunk caliper measured at six inches above the ground for all street trees shall be no less than two inches. The Developer shall be required to maintain and warrant the trees survivability for one year after each tree is inspected and approved by the Enforcement Officer. All Street Trees must conform to the City of Hilliard Master Street Tree Plan.

Tree Protection

All existing trees shall be preserved by the property owner, developer or person in possession and control of the property. However, the Enforcement Officer may approve the removal of an existing tree, and issue a permit to do so, when the tree interferes with the proper development of a parcel, provided that the parcel is the subject of an application for approval of a preliminary or final plat, a zoning certificate, site plan, variance or a conditional use permit, or demolition permit, and one of the following applies:

- The tree is located within a public right-of-way or easement; or
- The tree is located within the area to be covered by a proposed structure(s) or within twelve (12) feet from the perimeter of a structure(s), and the proposed structure(s) cannot be located in a manner to avoid removal of the tree while at the same time permitting desirable and logical development of the lot; or
- The tree is located within a proposed driveway, parking area, lot or structure; or
- Trees that in the judgment of the Enforcement Officer is damaged, diseased, over mature, or
- Which interfere with utility lines, are an inappropriate or undesirable species, are located in an unsafe manner, or
- Are located in an undesirable location.

Tree Survey and Protection: Prior to any construction or demolition activities on a site containing existing trees, a tree preservation plan including a tree survey of existing trees (including trunk diameter, location and species) must be submitted to the City for review and approval. During all phases of demolition or construction, including a ten-foot radius from any public tree‟s critical root zone, all steps necessary to prevent the destruction or damage to protected trees shall be taken by the owner or developer or person in possession and control of the premises (the “tree preservation area”). All required protective fencing, frame or box, or other physical barrier must be erected around the tree preservation area and approved by the City Arborist.

Wooded Area Preservation
Tree Protection and Wooded Area Preservation

1. **Show the location of trees you want to save** on a plat of your property. Enlist the help of an arborist or forester to help decide which trees to remove and which to save. Some species are more sensitive to change than others.

2. **Harmonize your project with the natural terrain** and the trees you want to save. Consider this natural arrangement when you plan the location of buildings, sidewalks and driveways. You might also want to transplant trees that are less than two inches in diameter and in the path of buildings and other features.

3. **Protect "save" trees from soil compaction and severed roots** with barrier fencing of the critical root zone. Vehicles driving or parking over roots or construction materials stored over roots result in compaction of the soil which cuts off the air and water passages in the soil. Some cutting of roots near construction is inevitable but much is avoidable. Avoid soil compaction.

4. **Choose a builder who shares your commitment** to saving trees and who has tree preservation experience. In building as in most other undertakings, experience matters.

5. **Communicate your Tree-Preservation goals** to everyone working on the project. Work with planners and architects, engineers and utility managers to place improvements where the impact on trees will be at a minimum. Meet with all foremen, contractors and sub-contractors who will work on the site. Be sure dozer operators, truck drivers and others are aware of tree preservation signs, fences and rules.

6. **Provide aftercare** to help trees recover from the stress of construction. Water periodically, especially in times of drought, and mulch the trees. Remove aggressive or noxious plants from natural areas.

7. **In wildfire prone areas, break up solid areas of evergreens** and avoid planting trees close to buildings. Keep trees watered, regularly pruned and in healthy condition. Prevent build-up of needles and dead branches.

City of Hilliard Planting Standards
Endorsed by

Ohio Nursery & Landscape Association
Promoting a Plant and People Partnership

Refer to section 7 Planting Guidelines Pages 14-18

Purpose: To increase transplanting success by providing municipalities with the most current and acceptable tree planting procedures. This information, prepared in specification format, will enable communities to convey specific requirements to contractors, developers, and/or volunteers. It contains the fundamental elements necessary to ensure transplanting success, and is intended to be a template that can be expanded to address other project issues.

Endorsement: This information is approved and endorsed by the Ohio Nursery and Landscape Association, and the Ohio Department of Natural Resources Division of Forestry.

Assumptions: All plant material shall comply with American Standard for Nursery Stock ANZI Z60.1. All plant material has been selected based on site conditions and constraints.

Division of Forestry
Ohio Department of Natural Resources

Standards and Specifications for Pruning City of Hilliard Street Trees

1. ISA Certified Arborist shall supervise and be on the crew when trees are pruned, verification provided to Hilliard City Arborist before commencing contract and when requested.

2. Operations shall conform to OSHA (Occupational Safety & Health Administration) safety standards ANSI Z133.1, as well as state and local regulations.

3. Current Bureau of Workers Compensations certificates shall be required.

4. Personal and property liability policy shall be required for the amount specified by the City.

5. A List of references and work experience before work to commence, so the City Arborist can determine if company personnel have experience to perform proper pruning and safety.

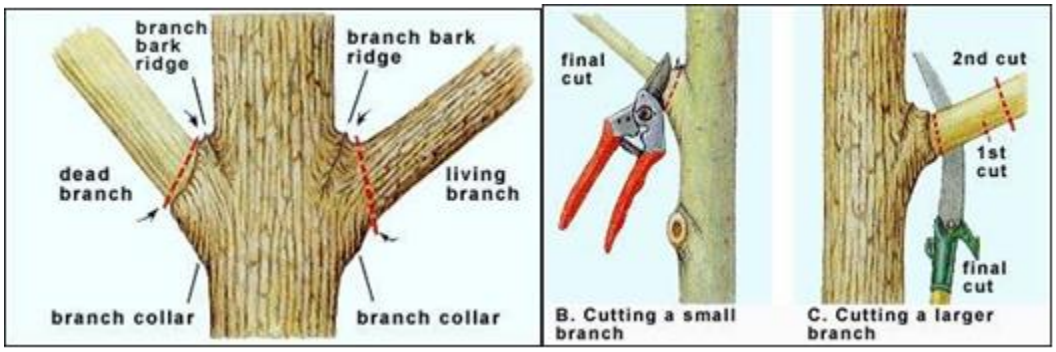
6. Certified Arborist shall visually inspect each tree before beginning work.

7. If a condition is observed requiring attention beyond the original scope of work, the condition should be reported to the Hilliard City Arborist.

8. Equipment and work practices that damage living tissue and bark beyond the scope of work should be avoided, loss of contract may result.

9. Climbing spurs shall not be used when climbing and pruning trees. There are to be no exceptions to this requirement except when an aerial rescue is being performed.

10. Tree branches shall be removed as illustrated in ANSI A300 (part 1) 2001



A: Make a partial cut from beneath
B: Make a second cut from above several inches out and allow the limb to fall.
C: Complete the job with a final cut just outside the branch collar.

11. Not more than 25% of foliage per tree shall be removed during pruning operations.

The above exhibit provides as example of removal of large and low limbs that if not removed will become weak, poorly attached limbs in the future. The removal of these limbs also develops a taller straighter trunk above the traffic of pedestrians and vehicles.

Never remove more than1/4 of a tree's crown in a season. Where possible, try to encourage side branches that form angles that are 1/3 off vertical (10:00 o‟clock or 2:00 o‟clock positions). Central leader or leaders as appropriate should be developed. Secondary leaders should be suppressed by pruning or removal as directed by a certified arborist, allowing a strong central leader to be developed. Ideally, main side branches should be at least1/3 smaller than the diameter of the trunk.

If removal of a main branch is necessary, cut it back to where it is attached to another large branch or the trunk. Do not truncate or leave a stub. For most deciduous (broadleaf) trees, don't prune up from the bottom any more than 1/3 of the tree's total height.

Topping and Lion's Tailing shall be considered unacceptable pruning practices for trees.

Don’t Top Trees!

Topping starves and shocks trees by removing much of the tree‟s protective “crown” of leaves and branches. Without its “crown,” a tree cannot produce the food necessary for growth, nor protect its sensitive bark from damaging sun and heat. The result is often cankering, bark splitting and the death of branches.

Topping weakens trees because the new branches that sprout from a severed limb are significantly weaker than the original limb. Weakened branches are much more likely to fall in a storm or in other adverse weather.

12. Cleaning shall consist of the removal of dead, diseased, and broken branches over 1/2" in diameter. Included shall be interfering branches greater than 1/2" that do not radiate out towards the branch tips.

13. Raising: shall consist of the selective pruning to provide vertical clearance.

14. All tree limbs extending over a sidewalk and/or pathway (trees in the planting strip between curb and sidewalk/pathway) shall be trimmed to such an extent that no portion of the same shall be less than nine feet above the sidewalk/pathway. Tree limbs extending over the streets shall be trimmed in such an extent that no portion of the same shall be less than eleven feet.

    Trees in excess of 25 feet shall be pruned so that they have a balanced canopy of no less than twelve feet above the sidewalk, pathway and/or street.

    Under no circumstances should low limbs be raised so that the canopy is less than half the total tree height.

15. All tree debris shall be removed from the site and disposed of legally.

Appendix

Information used in this brochure found at the following links:

Agriculture and Natural Resources
www.extension.osu.edu/counties

American Nursery Landscape Association
www.anla.org

City of Hilliard
www.cirtyofhilliard.gov

International Society of Arboriculture
www.isa-arbor.com

Ohio Chapter ISA
www.ohiochapterisa.org

Ohio Department of Agriculture
www.ohioagriculture.gov

The National Arbor Day Foundation
www.arborday.org

The Ohio Department of Natural Resources
www.dnr.state.oh.us

The Ohio State University
www.webgarden.osu.edu

Tree Care Industry
www.natlarb.com

Terms and Definitions

References used in the compilation of this glossary include:

Michael A. Dirr, Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses. (Champaign: Stipes Publishing, 1998)

William M. Harlow, Fruit Key and Twig Key to Trees and Shrubs. (New York; Dover Publications, Inc.,
1946)

William Trelease, Winter Botany: An Identification Guide to Native Trees and Shrubs. (New York; Dover
Publications, Inc.,
1931)

For the purposes of this Brochure the following definitions shall apply unless the context clearly indicates or requires a different meaning.

Acidic soil: A soil with a pH below 6.6 as determined by a soil test.

Alkaline soil: A soil with a pH above 7.3 as determined by a soil test.

Branch Bark Ridge: A ridge of bark that forms in a branch crotch and partially forms around the stem resulting from the growth of the stem and branch tissues against one another. It marks where branch and bark tissue meet.

Branch collar: "Shoulder" or bulge formed at the base of a branch by the annual production of overlapping layers of branch and stem tissues.

Caliper: Diameter of a young tree measured at 6" (for trees up to and including 4" caliper) or 12" (for trees over 4" caliper) above the ground line.

Canopy: Upper part of a tree. It includes branches and leaves.

Central leader: The main stem of the tree from which other branches develop. In most cases, it is the trunk.

Certified arborist: Professional arborists tested by the International Society of Arboriculture (ISA). A certified arborist must possess the technical competence to manage trees in the residential, commercial and private landscape. They must also earn the continuing education units (C.E.U) required by ISA.

City Arborist: The person employed by the City to perform the duties and enforcement required hereunder:

(1) Promote the preservation of trees and the replacement of major trees removed in the course of land development so as to mitigate the impact of development;
(2) Promote the proper utilization of landscaping as a buffer between certain land uses and to minimize the possibility of nuisances including potential noise, glare, litter, and visual clutter of parking and service areas;
(3) Protect, preserve and promote the aesthetic appeal, character and value of neighborhoods with the placement of landscaping;
(4) Offer a minimum standard for the consistent appearance of plant material in the community landscape; and
(5) Soften the appearance of building masses and paved areas and reduce the generation of heat and storm water runoff.

Coniferous: Woody plant that produces seeds in cones. Most coniferous trees are termed "evergreen" since they keep their needles for two or more years before they die and drop off the plant.

Cultivar: A cultivated variety that has noticeable differences from the species, but these differences can only be retained through propagation by vegetative means such as cuttings or grafting.

Deciduous: Plants that normally have leaves only during the growing season and lose their leaves during the dormant season.

Dieback: The dying back of stems due to adverse weather conditions, insects, diseases or other causes.

Dormant: The period of the year when a plant is not growing.

Enforcement Officer: The City Arborist, or other person assigned by the Mayor, shall be known as the Enforcement Officer and shall enforce all provisions of Chapters 1331 and 921 pursuant to the following procedures. Whenever the Enforcement Officer determines that there has been a violation of this Code or has grounds to believe that a violation has occurred, notice shall be given to the owner, developer or person or persons in possession and control of the premises and responsible.

Flush Cuts: Pruning cuts that originate inside the branch bark ridge or the branch collar, causing unnecessary injury to stem tissues.

Lateral: A branch originating from the main trunk.

Lions Tailing: Lion-Tailing can be described as the excessive removal of branches from the lower two thirds of a stem or branch, or the removal of only lower and interior branches when pruning. Lion-tailing is harmful to trees and it increases susceptibility to wind-failure.

Person: Any person (including a person in possession of property), corporation, partnership, company, association, contracting firm or other entity, including those employed under a contract with the City.

PH Value: A numeric designation of acidity and alkalinity in soil. Soils are either acid (pH value less than
7), neutral (pH value 7) or alkaline (pH value greater than 7).

Photosynthesis: A process by which plants make sugar for energy by using the pigment chlorophyll, light energy from the sun, carbon dioxide from the air and water. This process produces sugar and gives off oxygen.

Public places: All property, sites or places owned by the City, including but not limited to park land, rights-of-way and municipal buildings.

Public trees: All shade and ornamental trees now or hereafter growing on any street, highway or any public places.

Root collar "trunk flare": The transition zone between the stem and the root sometimes recognized in trees and seedlings by the presence of a slight swelling just above the roots of a tree.

Street or highway: The entire width of every public way, easement or right-of-way when any part thereof is open to use by the public, as a matter of right, for purposes of vehicular and pedestrian traffic, and shall include alleys.

Sucker Growth: A secondary shoot produced from the base or roots of a woody plant that gives rise to a new plant)

Tree lawn: That part of a street or highway, not covered by sidewalk or other paving, lying between the property line and that portion of the street or highway usually used for vehicular traffic.

Trees:
Large trees: Those attaining a height of at least fifty feet.

Medium trees: Those attaining a height of twenty-six to forty-nine feet.

Small trees: Those attaining a height of not more than twenty-five feet.

Topping: A poor maintenance practice often used to control the size of trees; involves the indiscriminate cutting of branches and stems at right angles leaving long stubs. Synonyms include rounding-over, heading-back, dehorning, capping and hat-racking. Topping is often improperly referred to as pollarding.

Sapwood: The active xylem (wood) found right under the cambium that stores water and carbohydrates and transports water and nutrients.

Soil: Unconsolidated mineral and organic material on the immediate surface of the earth, serving as a natural medium for the growth of plants.

12.4 Master Street Tree Plan

At its regularly scheduled meeting on May 1, 2013, the Hilliard Shade Tree Commission unanimously approved the following Master Street Tree Plan:

Objective – A low risk, resilient, and perpetually functional urban forest

Strategy – Through proper tree selection, placement and time, the City of Hilliard will reduce the overabundance of any one species to create a well-adapted, sustainable, and effective community resource.

Target – Weak Dominance and Mixed Canopies: No tree genus will comprise more than 15% of public rights-of-way.

Procedure – When new or replacement street trees are required, selection will be based on site considerations (e.g. treelawn width, above or below ground obstructions, soil texture, etc.) and the percentage of existing tree genera.

Considerations – While each street will have a mixture of tree genera, trees on a particular street (based on other considerations) will be of the largest and same size class. When selecting the appropriate trees, consider the most severe pests, as well as which existing trees have adapted well (are of a large size) and which existing trees are causing problems.

The Hilliard City Arborist maintains a Master Street Tree list showing the preferred species of tree for each street in the City. Contact the City Arborist for a copy of this list.